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Costs Dictate Changes in Molding

Higher Prices for Materials and Freight Advances Force Pioneer in Use of Core Molds for Automobile Cylinders to Abandon Dry Sand in Favor of Green Sand Method

BY PAT DWYER

SOME foundries are planned and erected with a predetermined capacity for the production of a certain line of castings. The floor space is figured out carefully and a certain definite proportion set apart for the different operations incident to their production. As nearly as possible the work is routed in one general direction beginning with the pattern shop and ending at the shipping platform or stock rooms. The sand storage is located conveniently to the coremaking department and also to the molding floors. The core ovens are situated where they will take up the least valuable space and yet be readily accessible both for receiving the green cores and for the delivery of the cores after they have been dried.

With the many convenient and adequate methods now available for distributing molten metal to the floors it no longer is necessary to place the cupola as near the center of the shop as formerly. Consequently in the more recent installations the cupola is erected at the most convenient point in reference to the stock yard. The stock yard in turn, containing the coke, pig iron and scrap, is laid out to take advantage of the best available railroad service.

Molding machines and special appliances are installed and provided at definite points indicated on the plan before construction is commenced. Handling and conveying systems can be installed and in a great many instances operated to advantage because the work made in such a foundry probably will be of a standardized character and turned out on lines of mass production.

It readily will be apparent that the problems incident to the design of such a foundry will be radically different from those confronting a foundryman who undertakes to change and adapt a foundry built and operated on haphazard lines, into a shop competent to enter the automotive field on competitive lines. Yet this is what has been done within recent years at the Muncie Foundry & Machine Co. plant, Muncie, Ind., most efficiently.

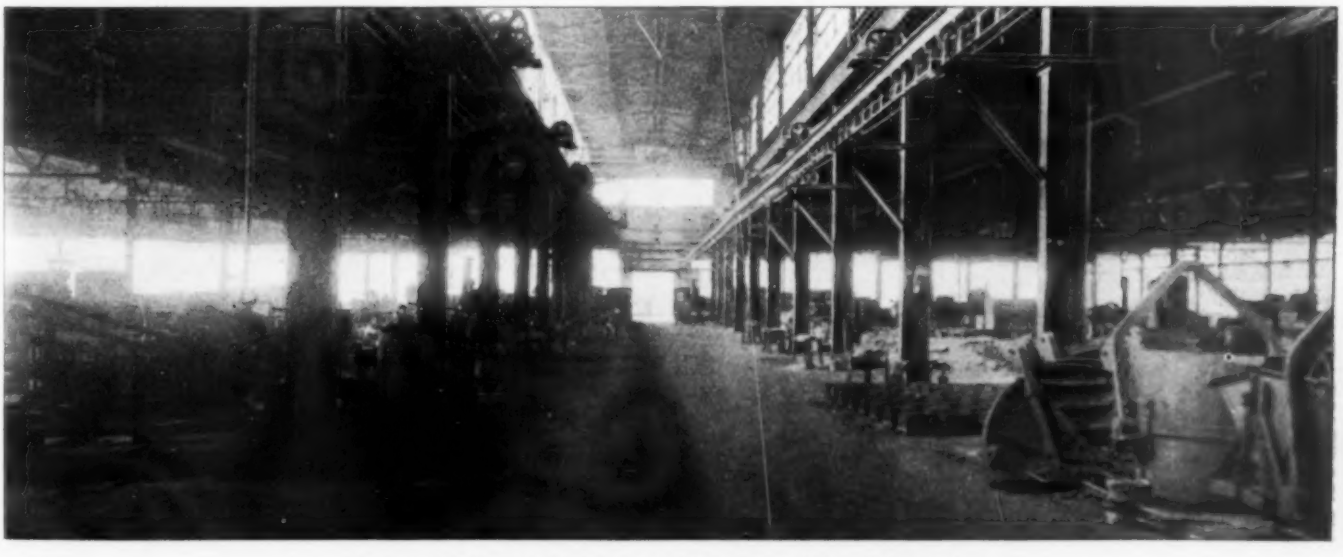


FIG. 1—GENERAL VIEW LOOKING WEST ON CENTER BAY

Originally established and conducted for a great many years as an ordinary jobbing shop it was placed on the market about 10 years ago to settle an estate. A group headed by Ed. Slatery and A. C. Lipsitz, who had obtained their automotive training in the foundry of the Buick Co., first at Detroit and later at Flint, Mich., was organized to take over the business and convert the establishment into an automobile castings factory. Mr. Slatery was elected president and Mr. Lipsitz, business manager.

The company shared in the general prosperity which characterized the growth of the automotive industry during the past 10 years. Additions and extensions were required and erected constantly until at the present time but little remains of the original building and equipment except part of one wall and one of the cupolas. The greater part of the old building finally was adapted for use as a core room and a large new building, the center gangway of which is shown in Fig. 1 was erected and equipped as a molding and casting shop.

FIG. 2—BALCONY AND ASSEMBLING FLOOR IN SOUTH CORE ROOM

This building, well lighted, heated, ventilated and modernly equipped in every way, was erected at right angles and adjoining the old building about the center. In fact, it includes part of the old building inasmuch as a section of the old side wall has been removed and the floor space is now all in one. The extension was built on the side of the old building opposite the cupolas so that now instead of being located about the center of one side wall they are at one end or in a position corresponding to the center of the cross bar on a capital letter T.

Before taking up the different departments and describing some of the methods and equipment in each it might be interesting to note that the management has shown equal versatility and adaptability in changing these as they have displayed in changing and adapting the buildings. It is held that because a machine or a method has given satisfaction in the past, is no warrant why it should be retained if changing economical conditions favor its discontinuance.

Three methods have been recognized and practiced since the beginning of the industry by the manufacturers of automobile engine cylinders. Taking them in the order of their relative popularity these are: Molds made in flasks, the exterior formed in green sand and the interior made in dry sand; molds made in flasks, both exterior and interior made in dry sand; and molds made entirely in dry sand without the aid of flasks. In addition to these a prominent Cleveland foundry company has developed a method, described in the Nov. 1 issue of THE FOUNDRY, for producing the castings in flasks entirely in green sand. The equipment for this latter development was completed only last fall just when the slump hit the automobile business, so it has not as yet received a thorough test on a production basis.

Each of these methods has its advantages and its disadvantages and factors vary so in individual plants that it is difficult, if not impossible, to institute comparisons. A method giving perfect satisfaction in one shop might well prove an expensive proposition in another and vice versa. The advocates of the green-sand mold claim it is the simplest and cheapest method for making a casting. Those who favor the dry-sand mold point to the fact that the safety factor assured by drying the mold more than off sets the added expense of the fuel required. Foundrymen who adopted the plan of making the mold entirely in core sand claim this process has all the advantages of the dry-sand method without the heavy initial expense of providing iron flasks.

The early training of the man directly responsible for the adoption of any method exercises a decided influence on his final decision. The foundryman who is thoroughly familiar with green sand and who has been accustomed to making satisfactory castings with that medium will prefer to continue using it. The one who has had occasion to note the beneficial effects of drying a mold may well feel a partiality for this method. So the foundryman who has devoted the greater part of his time to specializing in core production naturally thinks of the many advantages of that method when considering a new problem in mass production.

Mr. Slatery, the president and active head of the Muncie Foundry & Machine Co., is a coremaker by trade and

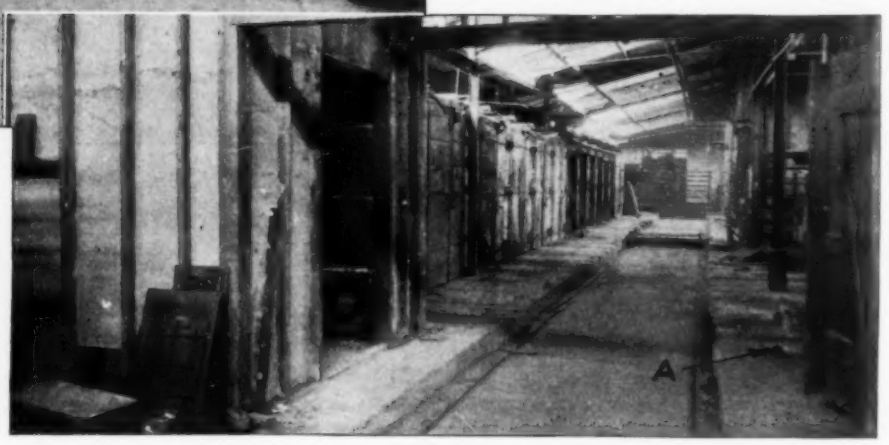
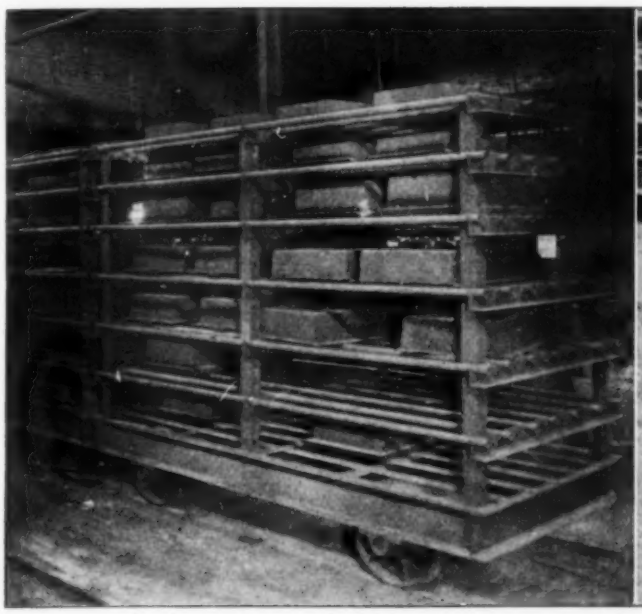


FIG. 3—DEPRESSED TRACK AND TRANSFER CAR IN NORTH CORE ROOM

therefore it is not surprising to find that for many years the automobile cylinders made by the company were made entirely in core sand without the aid of flasks. In making the change recently from this method to that of molding green sand in flasks it is claimed the costs of sand and oil have increased to a point where commercial advantage is no longer secured by drying the molds. In this connection it must be remembered that while the green sand can be used over and over again, the entire body of sand forming the core-mold is taken to the dump after the casting is shaken out.

During the years the core sand process has been in use at the Muncie foundry an enormous pile of used core-sand has accumulated. To dispose of this an agreement recently has been entered into with the railroad company



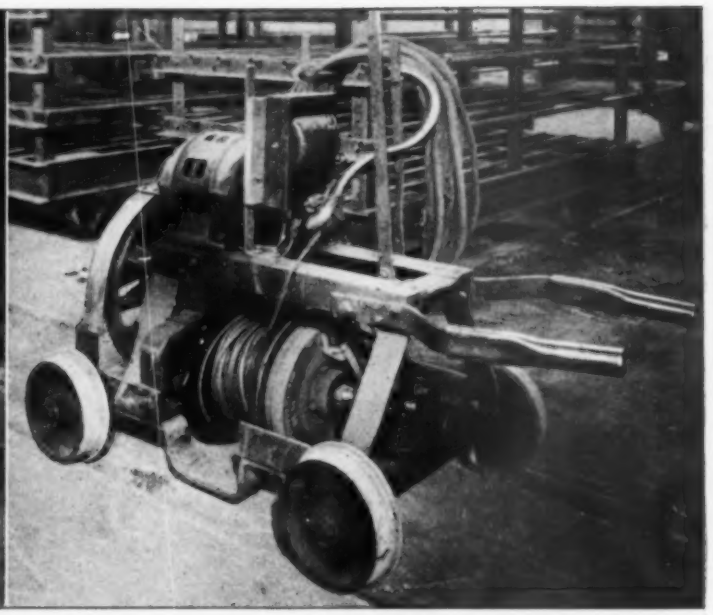


FIG. 4—TYPE OF OPEN-FRAME TRUCK USED IN ALL THE CORE OVENS FIG. 5—HOMEMADE DEVICE FOR PULLING THE CARS OUT OF THE OVENS

to haul the material away for fills. The foundry company has installed a bucket elevator and magnetic separator for loading the cars and reclaiming the scrap. The railroad supplies the cars and hauls the material away free but the foundry company stands the expense incident to loading the sand.

Perhaps the best and most intelligible method of presenting a description of the plant and its methods would be to take each department in turn and in the order through which the work passes from its inception to its final disposition. This would include the office, the power station, the pattern shop, the core room, the molding and casting shop, the melting department and finally the cleaning and shipping department.

A new 2-story concrete office building recently has been erected and serves to house the executive and clerical forces and also the draftsmen employed by the company. One of the rooms has been set apart as a display room and typical castings sawed apart at various points are shown in it to illustrate the absolutely accurate and uniform thickness of the metal section throughout the casting.

The power house is located in a building which also houses the pattern storage and a brief description of the equipment is as appropriate at this point as elsewhere. Four Ingersoll-Rand belt-driven air compressors supply all the compressed air required. The largest has a capacity of 1000 cubic feet a minute; two are capable of supplying 446 feet each and the smallest can deliver 325 cubic feet a minute.

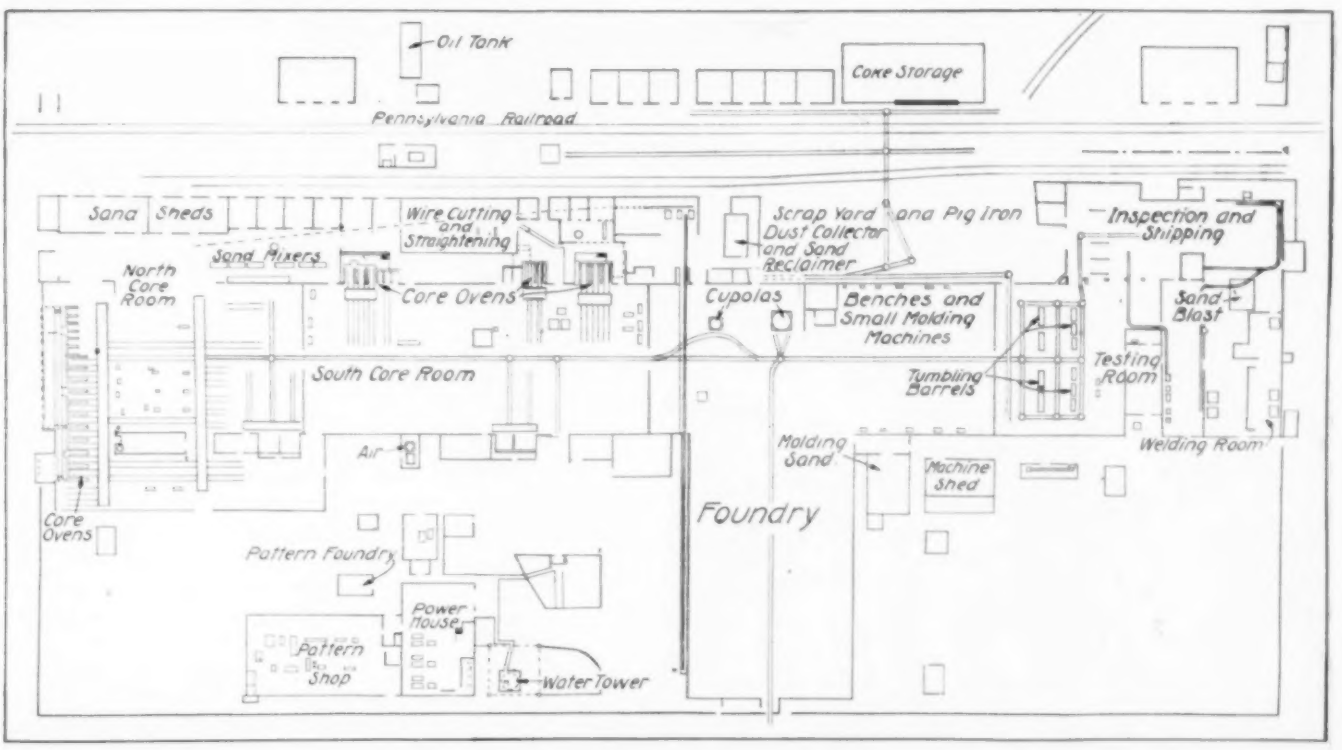


FIG. 6—GROUND PLAN OF THE FOUNDRY, CORE ROOMS, CLEANING ROOM, SAND AND GENERAL STORAGE AND CUPOLAS —THE GENERAL OFFICE, FORGE AND MACHINE SHOPS ARE LOCATED TO THE WEST BUT ARE NOT SHOWN

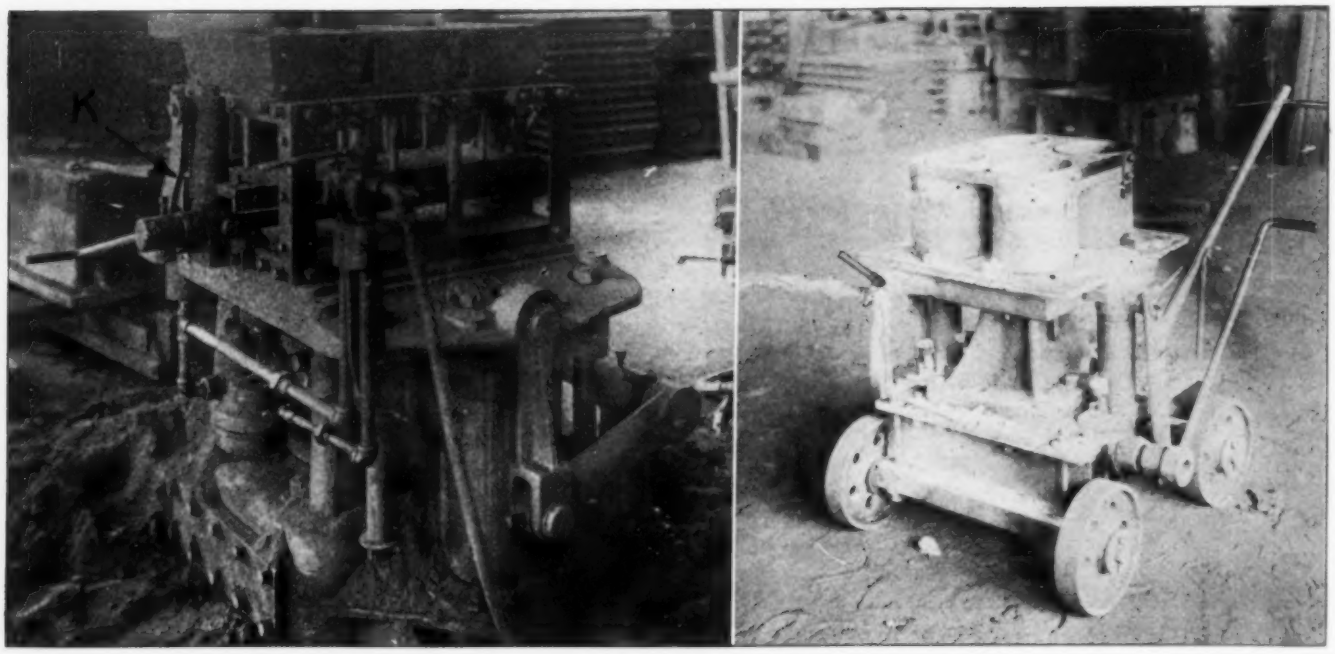


FIG. 7—THE RUNNER BASINS ARE JOLTED UP THREE AT A TIME ON A SPECIAL DEVICE ATTACHED TO A JARRING MACHINE. FIG. 8—RISER CUPS ARE RAMMED FOUR AT A TIME ON A PORTABLE BUMPER EQUIPPED WITH A STRIPPING PLATE

The pumps and transformers are in the same building as the compressors. Current is supplied at 2300 volts, 60-cycle, 3-phase by the Indiana General Service Co., and is stepped down in the power house of the foundry company to 220 volts for power purposes and 110 for the lighting circuit.

The upper floor of the power house is fitted as a pattern storage. Suitable racks properly indexed and cataloged insure the proper location of every pattern and corebox and loose piece. In practice the pattern storage is in charge of one man who issues and receives the patterns, but so complete and accurate is the system that in an emergency practically any clerk or subforeman could go into the room and find a desired pattern.

The company's water supply is derived from a deep artesian well located close to the power house. Connection is maintained with the city water supply in case the capacity of the well should at any time become overtaxed.

The large, commodious, well-lighted pattern shop is equipped for the construction of both wood and metal patterns. The work benches and machinery employed by the wood patternmakers are located in the end of the building from which the photograph was taken and therefore are not shown in their entirety. The machinery, surface tables, benches and vises employed by the metal patternmakers are shown in the back ground.

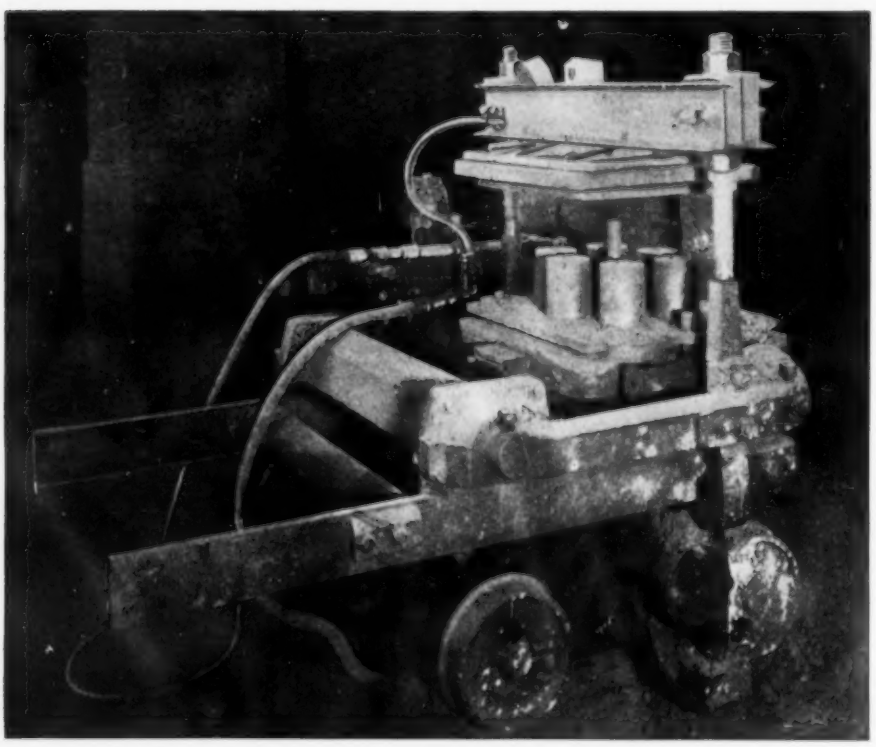


FIG. 9—ONE OF THE SEVERAL WAYS IN WHICH PISTON PATTERNS ARE MOUNTED ON MOLDING MACHINES

Has Repair Shop

In addition to this shop the company also conducts repair and fitting shops located a short distance from the main entrance to the foundry. Here the flasks and bottom plates are planed and fitted, adaptations made to molding machine equipment and the many other jobs that constantly keep turning up in a shop with a capacity of 150 tons a day and with a normal output of 100 tons a day.

The coremaking department, for long the dominating department of the plant, is divided into two main sections known as the north core room and the south core room. Owing to the many changes and extensions made from time to time they are irregular in contour, but both occupy approximately the same floor space, the north core room covering 35,490 square feet while the south core room occupies 33,800 square feet. The combined area of the L-shaped foundry floor, including the space occupied by the cupolas, is 35,152 square feet. From this it will be seen

that either of the core rooms is as large as the foundry and that together they occupy twice as much space as the area devoted to molding and pouring the castings. Now that the methods have been changed and as business conditions warrant, a considerable part of the area formerly set apart for the production of cores will be converted to other uses.

No definite plans have been made in regard to how this space will be utilized in the future. Several tentative arrangements are under consideration but they all are subject to the manner in which the automobile casting business may come back.

The arrangement of the battery of ovens in the north core room together with the depressed track and the transfer car employed for switching the cars from one track to another are shown in Fig 3. A number of these ovens were built and installed by Young Bros., Detroit, while the remainder were built by the company's own employes. Of the 14 ovens in the battery, 8 are heated by electric current and the remaining 6 by gas. Exhaust fans discharging into a number of stacks are employed to draw the steam and fumes out of the ovens while the cores are drying. The type of car used in both core rooms is shown in Fig. 4. An iron ring, one of which may be seen at *A* Fig. 3 is anchored in the floor opposite each oven. When the time comes to pull a car out of the oven a portable snatch block is attached to one of these rings. A wire cable provided with a hook at one end and the other end fastened to a drum geared to a discarded automobile mo-

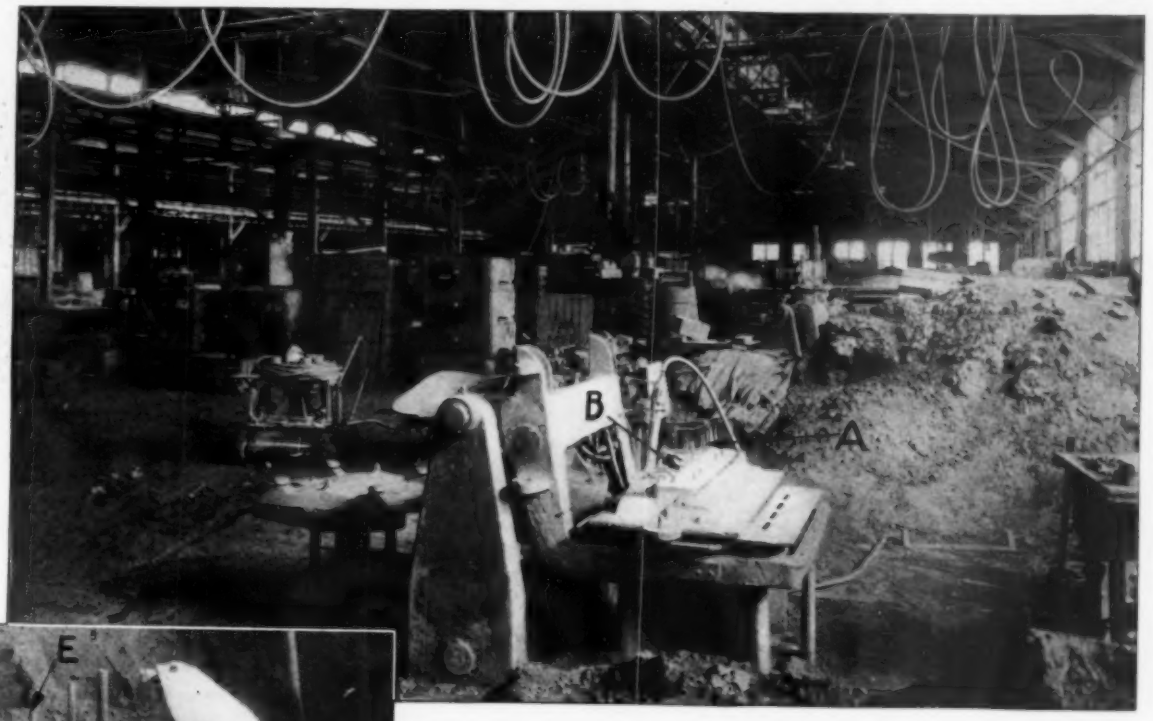
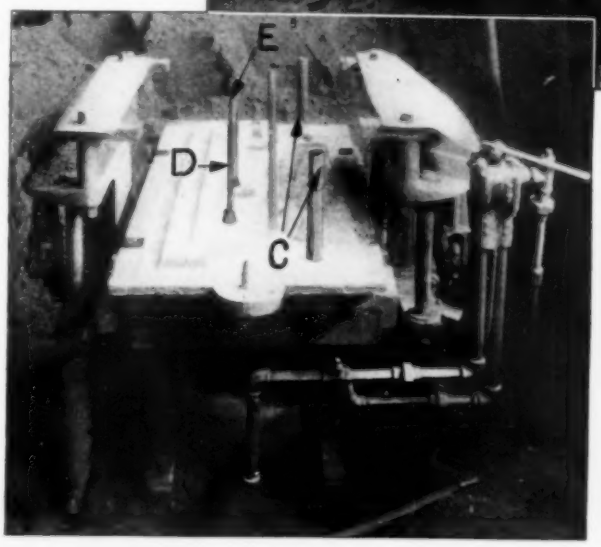


FIG. 10—PATTERN AND FLASK EQUIPMENT FOR MAKING COPES FOR JOB SHOWN IN FIG. 11

FIG. 11—DRAGS FOR THE LEXINGTON CYLINDER HEAD ARE MADE ON A JOLT RAM ROLLOVER PATTERN-DRAW MACHINE



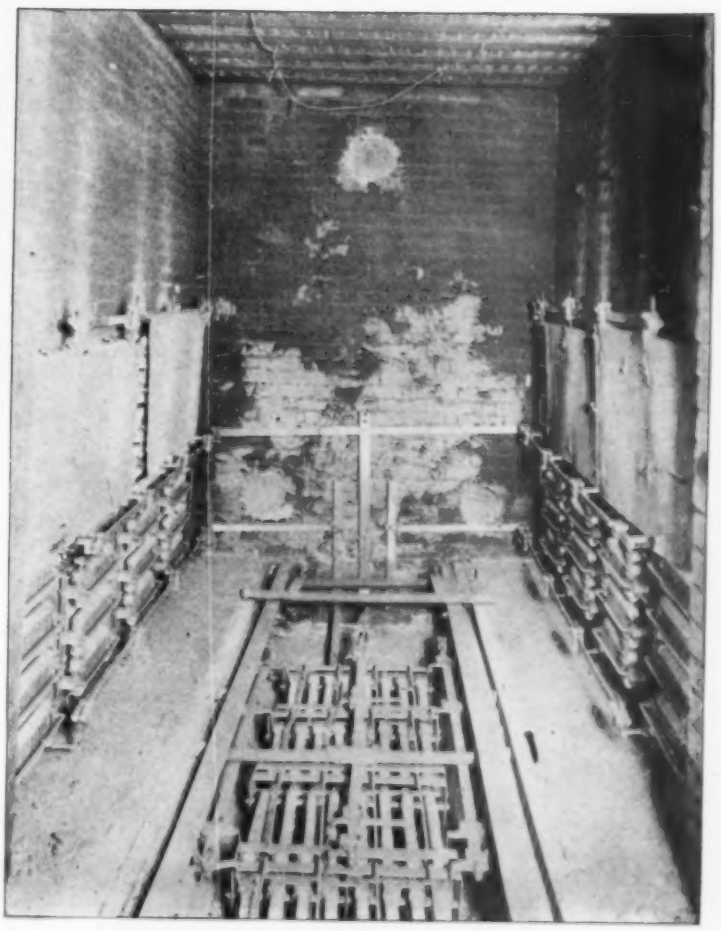


FIG. 12—INTERIOR OF ELECTRIC CORE OVEN

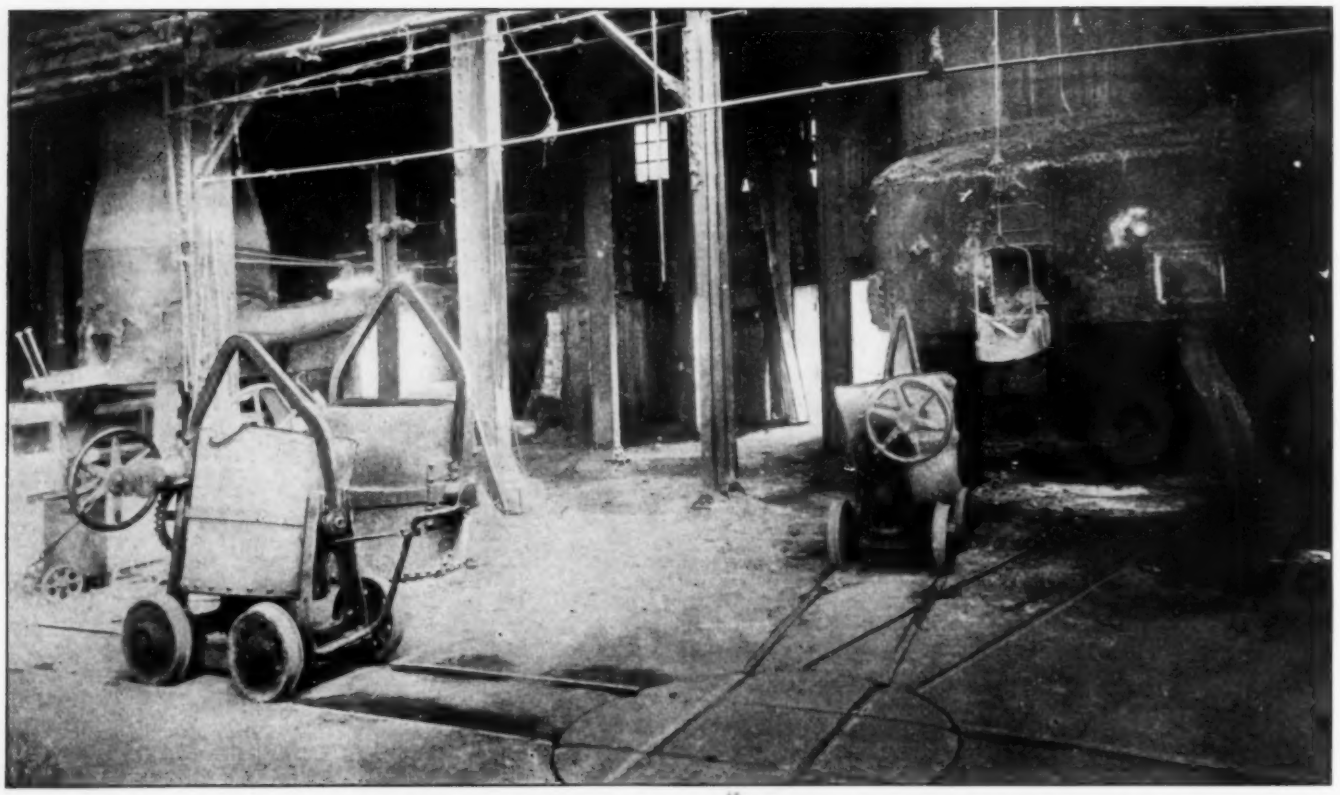


FIG. 13—IRON CAN BE DIVERTED BY MEANS OF THE SWINGING SPOUT TO EITHER LADLE ON A FORKED TRACK

tor located under the floor opposite the center oven, serves to pull the car onto the transfer car. From the transfer car it is pushed by hand on to the track leading to the pasting and assembling benches.

An interesting series of tests conducted shortly after the electric ovens were installed indicated that electric current is efficient as a drying medium. In addition it is stated that the heat is more uniform, cores drying equally as well on the top as on the bottom or middle of the car. Further, the heat generated seems to be of a different character than that of a coke, gas or oil fired oven.

In a large measure the satisfactory results attained were due to the thermostat controlling device which kept the ovens at a uniform temperature. When the heat reaches a predetermined point, the current automatically is cut off and when the temperature drops far enough the current again is thrown on. Hence it is possible at all times to maintain a maximum temperature without the attendant risk of burning the cores. The method of applying the heat is shown in Fig. 12. Four coils are located on the floor between the rails and four additional coils are attached to each of the side walls about half way up. Each of the ovens has inside dimensions 5 x 6 x 9 feet and as the cars measure 4 x 5 x 8, there is a clearance of 6 inches all around.

For purposes of comparison the cores were divided into two general classes. All those under 13 pounds were classified as light cores and all those over 13 pounds were designated heavy cores.

FIG. 14—COKE IS UNLOADED FROM THE CARS BY THE MECHANICAL UNLOADER SHOWN IN THE MIDDLE BACKGROUND

On this basis six car loads were dried in each oven and careful records kept of all the factors entering into the operation. Summarizing the results of these tests, the general average worked out as follows for the light cores:

Number of cores on car, 490.
Total weight 2230 pounds.
Drying time, 3 hours.
Total kilowatt hours per car load 130.

For the heavy cores the various items showed the following general average:

Number of cores on car, 40.
Total weight, 2420 pounds.
Drying time, 5 hours.
Total Kilowatt hours per car load, 250.

FIG. 15—CASTINGS ARE TAKEN BY CONVEYOR TO THE GRINDING AND CHIPPING ROOMS

In the core room machines made by four different manufacturers are in operation. Piston and barrel cores are made on three machines furnished by Wm. Demmler & Bros., Kewanee, Ill., These lift the sand and shoot it into the coreboxes under pneumatic pressure. Several of each type of hand and power jolt machines were supplied by the Grimes Molding Machine Co., Detroit; International Molding Machine Co., Chicago, and the Osborn Mfg. Co., Cleveland.

Part of the south core room is shown in Fig. 2. It is approximately 260 x 130 feet. The floor of smooth concrete construction is divided in the center by an industrial track. Two batteries of ovens, one battery heated by electricity, the other by gas or oil, are located well back from the track on the eastern side of the floor. Four ovens on the opposite side of the floor are employed exclusively for drying cores after they have been pasted or sprayed with blacking.

A few drawer type ovens are provided in this room but the greater number are of the standard truck type. A different method is employed for pulling the cars in the south core room from that which prevails in the north core room. Neither a depressed track or transfer car is employed. The cars are pushed into the oven by hand. They are cool at the time and easily handled. The rig shown in Fig. 5 is employed for pulling the cars out of the ovens. It was built by the company itself and comprises a 2-horsepower motor geared to a drum mounted on a frame and four wheels. It operates on the industrial track and when not in use can be lifted off and set on the floor in any place where convenient.

The elevated balcony shown in the center of Fig. 2 is used for pasting, assembling and storing the small cores. In addition to the industrial track extending through both core rooms and into every department of the foundry an overhead conveyor system supplied by the Lowden Machinery Co., Fairfield, Iowa, also is employed for transferring cores from the core room to the molding floors. In Fig. 1 it will be noted that the conveyor installation is supported on brackets attached to the columns on both sides of the main gangway in the foundry building while in the core room as shown in Fig. 2 it is suspended from the roof beams.

Old core sand is used to a limited extent, but the great bulk of the cores are made entirely of new sand bonded with linoil. In extreme cases it has been possible to secure a ratio of 1 to 60, but the average ratio is 1 to 40 or 45. Two grades of sand are used in varying proportions in the different mixtures. One is lake or sharp sand and the other is bank sand from Berlin, Wis. The latter is a sharp sand and yet has enough body to assist materially to retain the shape of the cores while green and during the drying process.

Sand Storage

The sand bins as may be noted by reference to Fig. 6 are situated along the eastern side of the north core room and closely paralleling a switch from the Pennsylvania railroad. Three additional bins are provided in the same relative position outside of the south core room. Each core room has its own sand mixing equipment comprising in each instance two 6-foot grinding pans provided with bucket loaders made by the National Engineering Co., Chicago, and one paddle type mixer made by the Blystone Mfg. Co., Cambridge Springs, Pa. These units are employed alternately, thus insuring at all times a spare set in case of emergency.

FIG. 16—SHOWING A CLAMPED MOLD WITH POURING BASINS AND RISERS IN PLACE—THE IRON FRAME ACROSS THE TOP SERVES TO ANCHOR THE PIECES OF PIPES USED AS CHAPLETS

Adjoining the space occupied by the coremaker's benches and machines in the south core room an area 40 x 80 feet has been partitioned off and equipped with the necessary machines and appliances for straightening, cutting and afterward bending to the required shape, the wires and rods used in the core room. In addition to the coils of new material used for this purpose,

a considerable quantity of the rods and wires are reclaimed after the castings have been poured. If necessary these are straightened and rebent to the required shape.

A double row of columns serves to separate the main molding floor into three main divisions. The columns are spaced on 26-foot centers longitudinally and are set 30 feet apart transversely as indicated in Fig. 1. All the molds are made on the 45-foot floors extending from the columns to the side walls. The bay in the center is kept clear for the transportation of materials. It is spanned by a 5-ton electric traveling crane made by the Whiting Corp., Harvey, Ill. Other appliances for handling molten iron, cores, sand, flasks, etc., are the Lowden conveyor already referred to; two storage battery trucks made by the Elwell-Parker Co., Cleveland; one truck made by the Buda Co., Harvey, Ill.; one by the Lakewood Engineering Co., Cleveland, and another by the Shop Mule Equipment Corp. of America, Chicago.

The molding machine equipment includes many sizes and types, from the small hand squeezer used on the light floors in the old part of the foundry to the heavy, rollover, jar-ram machines employed for making the cylinder molds. Of these machines the Davenport Machine & Foundry Co., Davenport, Iowa, furnished 23; the Grimes Molding Machine Co., supplied five; 10 were made by the Arcade Mfg. Co., Freeport, Ill.; four were furnished by the International Molding Machine Co.; and 11 by the Osborn Mfg. Co.

Making the Mold

The method employed for molding a Lexington cylinder head, shown in Figs. 10 and 11 is typical of the manner in which many of the jobs are rigged to simplify the work of the operators and secure maximum production. The drag pattern made of white metal is attached to a pattern plate mounted on a jar-jam rollover machine. The equalizer stand on the opposite side of the machine from the ramming cylinder automatically levels the drag after it has been rolled over and insures an accurate pattern draw. The row of pins shown at *A*, Fig. 11 serve as permanent vent rods and eliminate the necessity of the molder going over each mold with a vent wire before setting his cores. The casting is poured at the bottom through several small, thin, flat gates. These gates in turn are connected with a long horizontal runner extending the full length of the core print and communicating at the back of the print with the two uprights *C* Fig. 10.

The cope pattern Fig. 10 is mounted on a plain jar-ram stripping-plate machine. The cope is not rolled over; when it leaves the machine it is ready to go on the drag. The two runner pins are shown at *C* and the permanent vent rods at *D*. Three pieces of ¾ pipe shown at *E* serve as chaplets to hold down the core. These pieces of pipe are loose and come away with the cope. After the mold is closed the iron frame, *F*, Fig. 16 is placed on top of the cope. The cross bars in the frame come in line with the tops of the pipes and a couple of small wedges slipped between the bar and the pipe holds the latter firmly in place.

Pouring Basins

A row of the molds described in the preceding paragraph is shown in Fig. 15. The details of pouring basin, skim core and risers are clearly indicated. Instead of making up the pouring basins and risers on top of the closed molds two plain jolting machines, one made by the Arcade Mfg. Co., Freeport, Ill., and one by the Davenport Foundry & Machine Co., Davenport, Iowa, are employed for the purpose. The machine for making the pouring basins is shown in Fig. 7 and that for the risers in Fig. 8. The special attachments required in each case were developed and made on the premises.

It will be noted by reference to Fig. 7 that three pouring basins are made at one time. Three blocks, similar to the one shown at *G*, Fig. 16, are placed on the table of the machine. They are guided into their proper position by suitable rods which pass through the plate and fit into suitable depressions in the bottom side of the blocks. The rods are bolted on the lower end to a plate which can be moved up and down by the lever *K*, Fig. 7. These rods also serve to make the holes in the bottom of the basins through which the metal enters the mold.

After the blocks have been set the cast iron runner frames are placed around them, filled with sand and jolted a few times. The crank handle on the lever is given a half turn, this in turn pushes the rods up to the top of the pouring basins, carrying the blocks with them. The blocks are taken off and set aside; another turn of the crank pulls the rods down through the plate and then the pouring basins are lifted off and set on the closed molds. The block for forming the basin is provided with a shoulder at each end, also a runner opening so that no matter which way it may be set on the cope it will be right. One of the skimmer cores which is made to fit tightly against the shoulder is shown at *H*, Fig. 16.

The method adopted for making the risers is shown in Fig. 8. A stripping plate provided with suitable guides for locating the rings and with plugs for making the openings is mounted on a small portable jolt machine. The frame shown on top of the rings is an *upset* designed to hold the surplus sand before it is shaken down. After the molds are jolted they are stripped by means of the handle attached to the lever on the side of the machine. They then are taken and set over corresponding openings in the cope as in the case of the pouring basins.

Each of the molding floors is spanned by a light traveling crane from which a ½ ton air hoist made by the Curtis Pneumatic Machinery Co., St. Louis, is suspended. In addition an adapted Brillion pouring device forms part of the equipment for handling the iron. The adaptation consists in retaining the bridge and the substitution of a plain hook for the tipping and elevating device which forms the distinctive part of the system. Since the molding floor is perfectly level and since all the molds on a floor are approximately the same height it is not necessary to lift or lower the ladle. Before starting to pour, suitable hooks are attached to the carrying device. The ladles are filled, without lowering them to the floor, from a large ladle suspended from the traveling crane in the center gangway, or from a ladle suspended from the conveyor which, as already pointed out, extends along both rows of columns. Pivoted pig molds mounted on stands are provided in the center gangway, close to each column, to receive any cold iron left in the bottoms of the ladles.

Makes Pistons in Old Section

Pistons and other small parts are made in that section of the building which formed part of the old foundry. Several methods are in vogue for making piston castings. Some are cast with the closed end up and others are cast with the closed end down. Some are made altogether in green sand and others are made in green-sand molds, but with dry-sand cores. Patterns are mounted singly, in pairs, in fours and as shown in Fig. 9 with six patterns on one plate. In this instance the mold is made altogether in green sand and poured with the closed ends of the pistons up.

Iron is melted in two cupolas, one with a 76-inch shell lined to 54 inches, built by the Northern Engineering Works, Detroit, and the other with a 102-inch shell, lined down at the present time to 72 inches, supplied by the Whiting Corp. Blast is furnished by two blowers made by P. H. & F. M. Roots Co., Connersville, Ind., the

smaller one driven by a 35-horsepower and the larger by a 60-horsepower General Electric motor. The general arrangement of tracks and turntables in front of the cupola is shown in Fig. 13. It may be noted that the track leading from the turntable to the spout of the large cupola is forked, one branch leading to each side of the spout. To facilitate filling the ladles without having to stop the stream a supplementary spout has been suspended beneath the main spout of the furnace. To prevent the iron from spilling on the floor the lips of the two ladles are inclined toward each other, and it has been found that the spout then may be manipulated and the stream of iron diverted from one to the other without trouble.

Part of the stock yard is shown in Fig. 14. The coke, scrap and pig iron making up the charge are loaded on trucks and pushed by hand to the foot of an incline leading to the charging platform. At this point the hook on the end of a long cable is attached to the car and the load is pulled up the incline by a small electric hoisting winch. A depressed track and transfer car serves to take the loaded car to any point across the width of the charging platform. The remainder of the floor is covered with thin steel plates over which the cars easily can be pushed to any desired point.

The shop scrap, sprues, gates, etc., are all gathered up at night and loaded into small wooden boxes which in turn are stacked several tiers high on one of the trucks employed for conveying the materials to the charging platform. The boxes are provided with projecting handles at each end and a number of small rings slipped over adjoining handles prevent the boxes from slipping off the car while going up the incline. The charge for the 54-inch cupola is made up of approximately 40 per cent pig iron and 60 per cent scrap of which 12 per cent is steel. The relative proportion of iron and coke in the 54-inch cupola is 2000 pounds of iron to 450 pounds of coke and in the 72-inch cupola this charge is doubled.

An elaborate system of gravity and power-operated conveyors eliminate hand trucking of castings in the cleaning rooms. The castings are taken in regular sequence, first to a battery of 13 tumbling barrels made by the Cleveland Nickel Works, Cleveland. From the tumbling barrels the conveyor shown in Fig. 15 takes them to a room fitted with benches and grinding stands. A second conveyor takes them to the testing room where the castings which require it are subjected to a water test. From the testing room they are conveyed to two rotary-table sand-blast cabinets made by the Pangborn Corp., Hagerstown, Md., and from there to the inspection and shipping room. Accessories to the cleaning room are an oil-fired furnace in which castings with minor defects are preheated for welding and a sand drying stove used for drying the sand for the sand-blast apparatus.

A core sand reclaiming system installed by the W. W. Sly Mfg. Co., Cleveland, stands immediately outside the cupola room. An endless belt conveyor serves to carry the material from a space set apart at one end of the building for that purpose. On its passage to the reclaiming hopper the sand passes over a magnetic separator made by the Dings Magnetic Separator Co., Milwaukee.

High-Sulphur Malleable Made in America

By James H. Anderson

High sulphur iron is generally characteristic of British malleable practice, as stated on page 325 of the April 15 issue of THE FOUNDRY, but the low-sulphur black heart malleable is made in several foundries in Great Britain and the high-sulphur malleable is produced in a number of American foundries. Among the American foundries making castings from high-sulphur iron is the South Bend Chilled Plow Co., South Bend, Ind., which employs the cupola process.

The material used in this process is high in sulphur and has as much as 3.50 per cent total carbon. When the writer was superintendent of this foundry he used 20 per cent steel scrap in the mixture, together with approximately 25 per cent No. 2 coke pig iron, the remainder being made up of hard iron scrap. This was charged on a bed of coke somewhat higher than used for gray iron. The pig iron was of the following average composition: Silicon, 2.40 per cent; sulphur, 0.09 per cent; phosphorus, 0.40 per cent; manganese, 0.60 per cent; total carbon, 3.40 per cent.

The tests shown in the accompanying table are from average samples. These three samples were treated identically being cast in the same mold from the same ladle on one gate. The test pieces were annealed along with the castings in a regular anneal. The oven was brought up to 950 degrees Cent. in 40 hours and held at this temperature 96 hours later which it was cooled slowly.

Another anneal of similar samples with identical conditions, except that the temperature was held only 76 hours, gave a hard iron with approximately 2.0 per cent combined carbon and 0.60 per cent free carbon. Castings annealed like the first lot except that the front wall of the furnace was torn down as soon as firing ceased, allowing the castings to cool more rapidly, had approximately 2.15 per cent combined carbon and 0.70 per cent free carbon. These castings also were hard showing the necessity for slow cooling.

The composition of the annealed castings, given in the accompanying table, show that this high-sulphur iron can be made satisfactorily although it has a large amount of combined carbon, due to the sulphur which prevents the entire breaking up of the combined carbon, even under the most drastic heat treatment. This combined carbon is in the form of pearlite and is the element which imparts the high strength to the finished metal.

Composition and Strength of High-Sulphur Malleable

Sample	A	B	C
Total carbon	2.70	2.65	2.68
Comb. carbon	0.80	0.73	0.83
Free carbon	1.90	1.92	1.85
Silicon	0.84	0.80	0.82
Sulphur	0.29	0.27	0.27
Phosphorus	0.17	0.17	0.17
Manganese	0.11	0.09	0.10

	Tensile Strength		
Samples	Yield point Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Elongation % in 1½ in.
A	40.120	60.123	4.9
	40.972	66.731	5.1
B	41.432	60.127	4.8
	46.171	65.339	4.7
C	42.165	62.873	4.5
	41,375	59,191	4.7

Credit Omitted by Error

In the article "Tests Show the Quality of Core Oils" in the June 1 issue of THE FOUNDRY credit for the photographs shown should have been given to the Werner G. Smith Co., Cleveland, to whom Mr. Harrington and THE FOUNDRY were indebted.

Death of Joseph Sidney Seaman

JOSEPH SIDNEY SEAMAN, one of the outstanding figures of the foundry industry, past president of the American Foundrymen's association and patron of research in the science of casting metals died at his home in Pittsburgh, Wednesday, June 15. Mr. Seaman was born in Harmony, Butler county, Pennsylvania, Aug. 14, 1839. He was educated in the public schools and in Conoquenessing Academy. When only 17 years old he removed to Pittsburgh, taking employment first as a carpenter, when for a year he helped one of his brothers build cabins for river steamboats plying in neighboring streams.

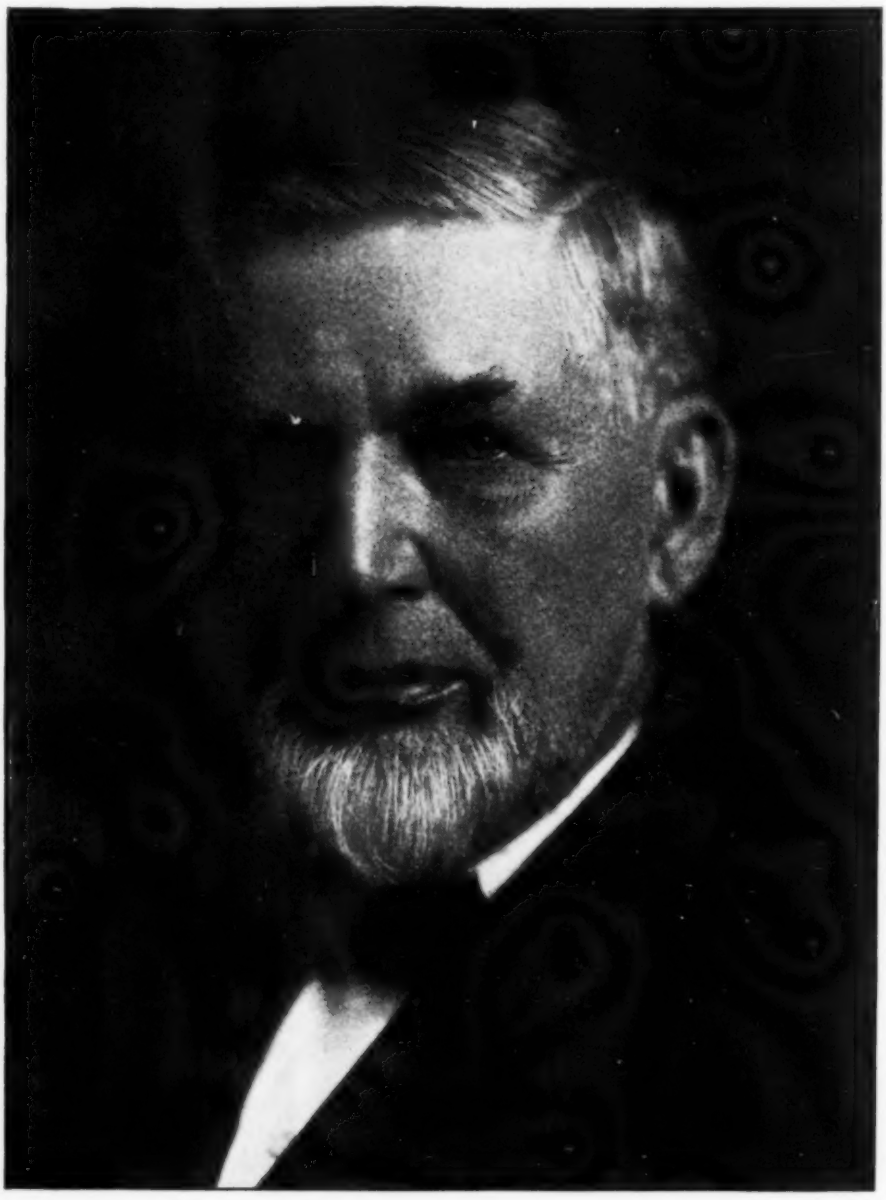
His identification with the metal industries, where he achieved such marked success, began with his association with Samuel Leonard, through whom he had the opportunity to learn the roll turning trade. For four years, Mr. Seaman worked in a shop in old Pipe Town, now Second avenue, Pittsburgh. Later he accepted a position with the Pittsburgh Foundry Co., which now is the A. Garrison Foundry Co. While employed with this company he turned the rolls which fabricated the first crucible steel made in Pittsburgh.

At the outbreak of the Civil War, he directed his attention to turning and finishing cannon for the Union forces. He was ambitious to join the army, but by reason of his skill he was informed that his duty lay with the second line of defense, in the arms factories of Pittsburgh. His desire for military service was met through enlistment in Kamp's battery of that city, but this unit was not called into service.

Mr. Seaman left the Pittsburgh Foundry Co. to take charge of the shop of Hussey, Wells & Co., where he worked for three years. The Black Diamond Steel Works, later engaged him to direct its work.

In 1869, Mr. Seaman embraced the opportunity to enter the foundry business for himself. With a few associates, he built a small shop at Liberty and 25th streets which was operated sucessfully under the names of Bollman & Co.; Bollman, Boyd & Baggaley; Baggaley Young & Co.; James B. Young & Co.; and Seaman, Sleeth & Black. In 1885 the Seaman-Sleeth Co. was incorporated by Mr. Seaman and Robert Sleeth. When in July, 1917, the Seaman-Sleeth Co., and the Phoenix Roll works were merged as the Pittsburgh Rolls Corp., Mr. Seaman was elected chairman of the board, with David L. Eynon, president.

During the period that Mr. Seaman operated the Liberty street plant, George Westinghouse was engaged in developing the airbrake and a number of other valuable mechanical devices. The first successful airbrake was made in the foundry in which Mr. Seaman was interested, and subsequently the Westinghouse Airbrake Co. purchased the foundry for its own use. The Seaman-Sleeth Co. later erected a new plant at Forty-second street. The company prospered and increased its capacity until its output was over five times what it had been at the start. On his seventy-fifth birthday, April 14, 1914, the employes of the company presented Mr. Seaman with a written testimonial, expressing their high regard for him as a man and an employer.



In 1891, when a meeting was called in Philadelphia to organize a technical society to represent the fast developing foundry industry, Joseph S. Seaman, Seaman-Sleeth Co., Pittsburgh, was one of the registered delegates and a factor in the formation of the American Foundrymen's association. From that time forward he was an active and earnest

worker in that organization and by his effective interest endeared himself to all who were identified with the association's development. In 1899, during the first Pittsburgh convention, Mr. Seaman was chosen president. He was the third man to achieve this honor.

During the convention of the association, held in Columbus in 1920, Mr. Seaman with three other veterans of the industry, J. H. Whiting, W. H. McFadden and John A. Penton established a fund to further research in the lines of scientific foundry knowledge. Mr. Seaman's gift of $5000 was given to provide an income which will serve to reward some noteworthy contribution to foundry knowledge. This action was followed by other donations for similar purposes.

For several years, Mr. Seaman has been the oldest ex-president of the association. He was a past president of the Pittsburgh Foundrymen's association, a member of the Duquesne Club, the Country Club, the Pittsburgh Athletic association, the Engineer's Society of Western Pennsylvania, the American Iron & Steel Institute, the Pittsburgh Chamber of Commerce, and the Chamber of Commerce of the United States. He was president of the Pennsylvania National Bank and the Pennsylvania Savings Bank.

Cuts Cost of Iron Mixture With Scrap

By H. E. Diller

Question—We have an order for some castings requiring an iron with approximately 2.90 per cent silicon, 0.08 per cent sulphur, 0.60 per cent phosphorus, 0.45 per cent manganese, 3.30 per cent total carbon and only traces of combined carbon. We now have some pig iron in the yard, which has 3.0 per cent silicon and 0.86 per cent manganese. A charge made of 60 per cent of this pig iron and 40 per cent stove plate scrap did not meet the requirements. Please advise us what kind of iron we should get to make the cheapest mixture, using 50 per cent scrap.

Answer—Practically any pig and scrap iron mixture of the composition you designate will meet the requirements for total carbon and should produce a metal with low combined carbon if melted properly and not chilled in the casting. To secure 0.60 per cent phosphorus in the casting you will have to buy an iron containing enough phosphorus to bring the average in the pig iron and scrap to the required amount. About 0.15 to 0.25 per cent manganese will be oxidized and lost in melting. This must be allowed for in purchasing the pig iron. The percentage of manganese in the iron can be increased by adding pea-size ferromanganese to the ladle or by putting a small amount of spiegeleisen on the charge, but either of these expedients would increase the cost of the mixture.

It will be difficult to keep the sulphur in cast iron made from a mixture of 50 per cent pig iron and 50 per cent stove plate scrap around 0.08 per cent, especially if the manganese must be held near 0.45 per cent. It would be necessary to use a low-sulphur coke to do this. If the iron then comes above 0.08 per cent in sulphur the sulphur might be lowered by adding an excess of limestone on each charge. This would add expense for the stone and extra coke required to heat it.

The correct amount of silicon can be obtained either by buying a pig iron high enough in silicon or by adding ferrosilicon to the charge in the cupola. If you use stove plate you should see that it is comparatively free from burnt iron. It would be better to use as much as possible of the scrap from this mixture. Calculating the scrap as containing 2.50 per cent silicon the cost of different grades of pig iron can be estimated.

The metal will lose 0.25 per cent silicon in the cupola, therefore, to secure 2.90 per cent silicon in the metal the charge will have to average 3.15 per cent silicon which can be secured with

Per cent of charge		Silicon
.50 x 2.50	=	1.25—Silicon in scrap
.50 x 3.80	=	1.90—Silicon in charge
Total.....		3.15—Silicon in charge

This shows that it will be necessary to have 3.80 per cent silicon in the pig iron. A pig iron could be purchased containing this amount of silicon or a pig iron with lower silicon could be used with ferrosilicon. The following prices of some available grades to select from were effective June 7:

	No. 2 foundry	No. 1 foundry	Ferrosilicon	
at Buffalo	$23.50	$26.50	....	....
at furnace	....	....	$32.00	$40.00
Freight to Detroit	3.64	3.64	3.64	3.64
Cost at Detroit...	27.14	30.14	35.64	43.64

If the No. 1 X is used, ferrosilicon will have to be added to bring the pig iron average up to 3.90 per cent silicon. The following is calculated on the basis of the use of the 10.00 per cent grade of ferrosilicon:

Per cent		Silicon	Total
.13	x	10.00	1.30
.87	x	3.00	2.61
Ave. silicon			3.91

This will cost per gross ton:

.87 x 30.14		$26.22
.13 x 43.64		5.67
Total		31.89

If No. 2 pig iron and 10.00 per cent ferrosilicon are used the cost can be figured similarly:

Per cent		Silicon	Total
.763	x	2.00	1.526
.237	x	10.00	2.37
Ave. silicon			3.896

This will cost per gross ton:

.763	x	27.14	$20.71
.237	x	43.64	10.34
Total			$31.05

These figures indicate that the cost of a charge would be cheaper if No. 2 pig iron is used instead of No. 1 X. The following example shows the relative cost when 6.00 per cent ferrosilicon is used in place of the 10.00 per cent grade as previously calculated. Using the same method of calculating:

Per Cent		Silicon	Total
.525	x	2.00	1.05
.475	x	6.00	2.85
Ave. Silicon			3.90

The cost per gross ton will be:

.525	x	27.14	$14.25
.475	x	35.64	16.93
			$31.18

From the foregoing figures it can be seen that on a basis of the cost of the charge the cheapest combination is one in which No. 2 pig iron is used with 10.00 per cent ferrosilicon. This can be secured at a cost of $31.05 per gross ton. However, the cost of the charge is by no means the only consideration in figuring costs. If the metal does not produce a high percentage of good castings the cost of defectives may be so high that the price paid for the iron is only a secondary consideration. Therefore, the fact must be taken into account that more leeway is had in melting the iron if the components of the mixture are approximately of the same composition than if a great variation exists in the amount of any element in the different grades of pig iron and scrap. Another consideration is the chance of variation in the scrap, which is greater with scrap purchased on the open market than when home scrap is used. This is the reason we recommend the use of as much as possible of your own scrap. A mixing ladle holding no less than a charge and a half will insure the more complete mixture of the metal before it goes into the pouring ladle.

It might be added that the mixture as figured with ferrosilicon will average somewhat lower than 3.30 per cent total carbon as the ferrosilicon is low in total carbon. However, when melted in the cupola this mixture will take up carbon from the coke so that it will come from the spout with approximately 3.30 per cent carbon.

Study Impact Tests on Cast Steel

Results Given of Investigations of Impact Tests on Cast Steels of Varied Compositions and Heat Treatments—Higher Shock Strength Obtained From Low-Phosphorus Material

BY F. C. LANGENBERG

FROM time to time the writer has been called upon to make impact tests on cast steel of varied compositions and heat treatments. The results recorded herein were obtained from four investigations, which can be briefly outlined as follows:

Investigation to determine the effect of phosphorus upon the physical properties of cast steel, made in the converter.

Examination of castings having different carbon and manganese content. These castings were manufactured by a private concern, the steel being made in a 3-ton basic electric furnace.

Experimental heat treatment of acid open-hearth cast steel.

Summary of impact tests obtained on forged steel submitted for comparative purposes with the results obtained on castings.

The nomenclature, cast steel Nos. 1, 2 and 3 is used throughout this report, and refers to the United States ordnance department classification of cast steel. In the original ordnance department specifications the only chemical requirement imposed upon the manufacturer was that the phosphorus should not exceed 0.05 per cent and the sulphur 0.07 per cent. During the war period these specifications were revised several times, and finally resulted in the following classification:

Cast steel	Elastic limit —Lb. per sq. in.—	Tensile strength	Elongation Per cent	Contraction Per cent
No. 1....	27,000	60,000	22	30
No. 2....	31,500	70,000	18	25
No. 3....	36,000	80,000	15	20

For convenience the investigation to determine the effect of phosphorus upon the physical properties of cast steel is divided into two groups. The first experiment consisted in making two pintle-bearing castings and four test coupons, two of the coupons and one of the castings having a phosphorus content of 0.043 per cent, and the other two coupons and casting having a phosphorus content of 0.104 per cent. In casting these coupons and castings the following procedure was adopted:

A regular No. 3 converter heat was selected, the ladle analysis of which showed the following composition: Carbon, 0.42 per cent; manganese, 0.86 per cent; silicon, 0.197 per cent; sulphur, 0.065 per cent; phosphorus, 0.039 per cent.

A small ladle was preheated and placed on the scales, and enough 20-per cent ferrophosphorus added to this ladle to bring 800 pounds of metal from 0.04 per cent phosphorus to 0.10 per cent phosphorus.

Immediately after the heat was down (cast-steel heat 5775) and properly recarburized, 800 pounds of metal was added to the small ladle. One casting and two coupons were then poured from the regular composition, and one casting and two coupons from the small ladle. The phosphorus, as determined from a sample taken from one of the coupons of the regular composition, was 0.043 per cent, whereas that determined from a sample taken from one of the high phosphorus coupons was 0.104 per cent.

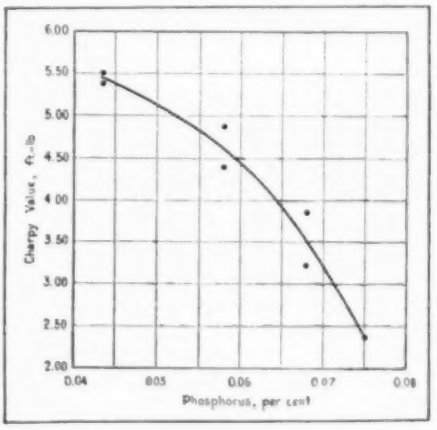


FIG. 1—EFFECT OF PHOSPHORUS ON SHOCK-STRENGTH OF STEEL CASTINGS

Experiment No. 2 consisted in making four different phosphorus contents from one regular No. 3 heat of converter steel. The procedure adopted was as follows:

A small ladle was thoroughly preheated as in experiment No. 1 and ferrophosphorus additions made to this ladle. As soon as the heat was down and properly recarburized, 1200 pounds of metal were added to the small ladle. Two pintle-bearing castings and two coupons were poured from the regular composition from the large ladle. Two castings and two coupons were then poured from the higher phosphorus metal from the small ladle, thus emptying the small ladle

Ferrophosphorus additions were again made to the small ladle and 1200 pounds of metal added. The remaining metal in the large ladle was then *doped* with ferrophosphorus, so as to bring its phosphorus content from the original estimated 0.04 per cent to 0.08 per cent. Two pintle-bearing castings and two coupons were then poured from both the large and the small ladle, thus consuming the entire heat.

The eight castings and eight coupons were then heat treated by annealing them at 950 degrees Cent. for two hours, chilling in air and then drawing for four hours at 500 degrees Cent.

Two test coupons marked 5775-1 and 5775-2, one pintle bearing marked 5775, two test coupons marked 5775-3X and 5775-4X, and one pintle bearing marked 5775X were annealed at 950 degrees Cent. for two hours and then air chilled. Subsequent to the air-chilling operation, they were drawn four hours at 500 degrees Cent., The letter *X* was used to designate all castings and coupons having a high phosphorus content. A number of determinations were

Table I
Charpy Impact and Brinell Hardness Tests

Heat No.	Carbon, per cent	Manganese, per cent	Charpy impact values Foot-pounds absorbed First test	Second test	Average	—Brinell hardness values— First test	Second test	Third test	Average	Appearance of fracture
239	0.44	0.93	9.89	10.07	10.01	197	197	197	197	Amorphous and crystallin
245	0.27	1.08	32.28	30.89	31.58	149	156	153	153	Amorphous
292	0.298	1.31	29.64	34.84	32.24	171	175	167	171	"
304	0.222	1.29	25.92	29.82	27.87	163	159	159	160	"
199	0.33	1.54	8.84	8.14	8.49	207	207	212	209	Amorphous and crystallin
276	0.346	1.76	6.28	7.22	6.75	197	197	207	200	" " "

Paper presented at the convention of the American Society for Testing Materials, June 21-24, by F. C. Langenberg. The investigation reported was made at the suggestion of committee A-4 on Heat Treatment of Iron and Steel.

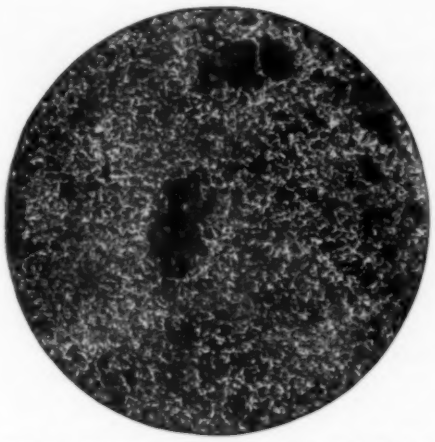


FIG. 2—QUENCHED IN WATER FROM 900 DEGREES CENT. AND DRAWN 4 HOURS AT 600 DEGREES

made on samples taken from coupons and cut tests, and it is believed that the following composition fairly represents that which was actually present.

Material	C.	Mn.	Si.	S.	P.
Per cent					
Coupon 5775-1.. Coupon 5775-2.. Casting 5775...	0.42	0.86	0.197	0.065	0.043
Coupon 5775-3X Coupon 5775-4X Casting 5775X..	0.42	0.86	0.197	0.065	0.104

After the annealing operation outlined above had been completed, all of the coupons and one-half of each casting were cut up for test. Charpy tests only were taken, the results of which were:

Material	Mean of 4 tests, ft.-lb.
LOW PHOSPHORUS MATERIAL	
Coupon 5775-1	6.28
Coupon 5775-2	6.90
Casting 5775	6.69
Average	6.69
HIGH PHOSPHORUS MATERIAL	
Coupon 5775-3X	2.87
Coupon 5775-4X	2.48
Casting 5775X	3.95
Average	3.10

An inspection of the general averages obtained above, incorporating tests from both coupons and castings, will show that considerable higher shock strength was obtained on the low phosphorus material. An increase in the phosphorus content from 0.043 per cent to 0.104 per cent decreased the shock strength by some 53 per cent. The two remaining halves of the pintle-bearing castings were then retreated by heating to 900 degrees Cent., quenching in water, followed by drawing at 600 degrees Cent., a treatment used previously with considerable success on the production of this casting for which particularly high properties are demanded.

Charpy tests were then made with the following results:

Material	Mean of 4 tests, ft.-lb.
Casting 5775	7.76
Casting 5775X	3.41

From these results it is also evident that an increase in phosphorus from 0.043 per cent to 0.104 per cent has reduced the shock strength by over 50 per cent.

Results of Experiment No. 2

As previously stated, eight castings and eight coupons were made in the second experiment. Chemical samples taken from the coupons gave the following results:

Coupon	C.	Mn.	Si.	S.	P.
Per cent					
5807A	0.42	0.65	0.282	0.069	0.043
5807B	0.40	0.63	0.300	0.069	0.058
5807C	0.42	0.60	0.273	0.066	0.068
5807D	0.41	0.61	0.273	0.065	0.075

The results of the tensile tests, together with the Charpy tests, the latter in each case being the average of four separate bars, are as follows:

Marks on specimen	Yield point, Lb. per sq. in.	Tensile strength, Lb. per sq. in.	Elong. %	Cont. %	Charpy test, ft.-lb.	Brinell hardness
5807A	51,000	89,000	21.5	24.0	5.43	163
5807A	52,000	87,500	15.0	16.9	5.50	149
5807B	51,500	87,500	17.0	20.5	4.42	192
5807B	50,500	86,000	17.0	20.5	4.88	175
5807C	51,500	88,000	19.0	16.9	3.25	...
5807C	52,000	89,500	19.5	24.0	3.88	...
5807D	52,500	82,500	7.5	9.5	2.40	...

Coupon discarded.

Fig. 1 was plotted from the results of these tests. It is evident from this curve that the phosphorus content has a decided relationship to the Charpy value. It would appear from this figure that the most decided decrease or falling off of the Charpy value occurs when the phosphorus content is increased beyond 0.06 per cent. In considering this curve it should be borne in mind that all of this material was poured from one heat, and that all conditions, excepting the phosphorus content, were maintained constant. That such was the

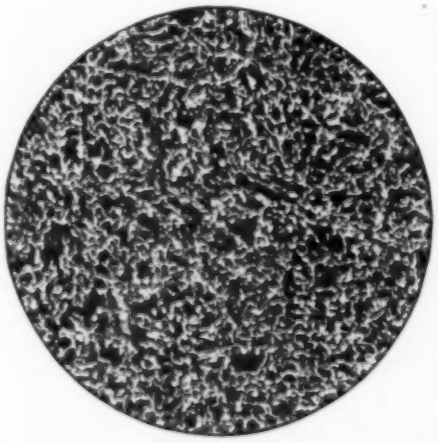


FIG. 3—ANNEALED 2 HOURS AT 950 DEGREES CENT., CHILLED IN AIR AND DRAWN 4 HOURS AT 500 DEGREES

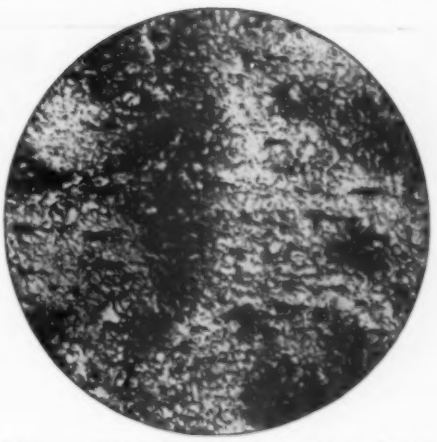


FIG. 4—PHOSPHORUS 0.104 PER CENT

FIG. 5—PHOSPHORUS 0.043 PER CENT

Table II

Physical Properties of Cast Steels of Different Heat Treatments

Marks	Yield point, lb. per sq. in.	Tensile strength, lb. per sq. in.	Elongation, per cent	Contraction of area, per cent	Charpy impact test, ft.-lb.	Brinell hardness
A	58,500	88,000	15.0	24.0		187
A	56,500	84,500	11.5	16.9	Average of 7 tests,	171
A	57,500	89,500	19.5	27.4	14.25	171
Average	57,500	87,333	15.3	22.8		176
B	44,000	75,000	10.5	20.5		156
B	50,000	82,500	25.0	37.0	Average of 8 tests,	153
B	45,000	80,500	19.5	24.0	11.32	159
Average	46,333	79,333	18.3	27.2		156
C	49,000	81,000	12.5	20.5		163
C	49,500	85,000	21.5	30.7	Average of 8 tests,	160
C	50,000	82,000	14.5	20.5	11.87	156
Average	49,500	82,666	16.2	23.9		159

Table III

Results of Charpy Tests of Forged Steels, Charpy Values in Foot-Pounds

C.	Mn.	S.	P.	Si.	Cr.	Original	V_1	V_2	V_3	V_4	V_5	V_6	V_7
0.14	0.45	0.035	0.018	0.131	...	45.39	28.01	38.10	47.18	47.95	49.50	48.34	52.61
0.18	0.56	0.043	0.024	0.132	...	41.51	30.72	35.69	46.24	45.00	44.62	46.87	50.51
0.32	0.51	0.027	0.009	0.128	...	22.96	15.20	10.94	18.85	19.24	19.86	22.34	26.30
0.46	0.40	0.050	0.020	0.144	...	10.70	7.99	....	14.04	13.96	13.89	15.67	16.60
0.49	0.60	0.028	0.013	0.127	...	12.72	10.32	....	16.06	14.51	14.35	17.53	19.24
0.57	0.65	0.028	0.012	0.167	...	8.38	7.91	....	12.57	10.86	11.17	12.02	14.04
0.71	0.67	0.035	0.027	0.147	...	4.42	2.48	....	....	4.73	7.60	10.32	15.67
0.83	0.55	0.028	0.018	0.152	...	1.31	1.39	....	....	3.42	3.33	4.34	6.36
1.01	0.39	0.029	0.016	0.160	...	2.09	1.47	....	....	3.25	3.18	4.19	4.42
1.22	0.34	0.031	0.025	0.181	...	1.39	1.31	....	....	2.48	2.09	2.63	2.63
1.39	0.20	0.029	0.015	0.191	...	0.93	0.85	....	....	1.86	1.31	1.47	1.62
1.46	0.20	0.035	0.011	0.133	0.35	0.77	1.24	....	....	1.94	2.01	2.01	1.94

Original, as received, probably hot rolled.
V_1 Annealed just above Ac3.
V_2 Hardened in water from just above Ac3.
V_3 Hardened in oil from just above Ac3.
V_4 Quenched in oil from just above Ac3, drawn at 375° C.
V_5 Quenched in oil from just above Ac3, drawn at 460° C.
V_6 Quenched in oil from just above Ac3, drawn at 560° C.
V_7 Quenched in oil from just above Ac3, drawn at 650° C.

case is further proved by the fact that little difference can be observed in the results of the ordinary static tensile test, excepting 5807*D* which showed a decided falling off in ductility. It would appear that if experimental conditions had varied to any great extent, the ordinary static tensile test would have shown more disagreement than is recorded.

It is particularly noticeable also that the effect of slight increases in phosphorus make themselves much more apparent by their influence upon the shock strength than upon the results of the tensile strength; 5807*C*, for example, shows static tests very similar to 5807*A*. The shock test, however, is decidedly inferior to that obtained on the low phosphorus material.

The eight castings, two of each composition, which have been previously referred to, were tested to destruction under a drop. Rough as this test was, it confirmed the results of the Charpy test; both indicated that a decided decrease in dynamic resistance occurs somewhere between 0.06 and 0.07 per cent phosphorus, and the indications are that this sudden decrease in dynamic resistance occurs more nearly at 0.06 per cent than at 0.07 per cent phosphorus.

For the examination of castings having different carbon and manganese content eight castings were received into the laboratory. These castings had all been air chilled at a temperature of 900 degrees Cent. The pattern number, heat number and composition were as follows:

Pattern	Heat No.	% Si.	% S.	% P.	% C.	% Mn.
42.....	239	0.56	0.032	0.042	0.44	0.93
42.....	245	0.42	0.011	0.030	0.27	1.08
27.....	292	0.28	0.014	0.043	0.298	1.31
58.....	304	0.10	0.014	0.033	0.222	1.29
81 & 79	199	0.31	0.015	0.038	0.33	1.54
42.....	276	0.26	0.016	0.047	0.346	1.76

Referring to the results of the Charpy test, it will be noted that the unusual Charpy values for castings: namely, those obtained on heats Nos. 245, 292 and 304, occurred when the carbon did not exceed 0.30 per cent and the manganese 1.31 per cent. With a carbon content of 0.33 per cent and a manganese content of 1.54 per cent on heat No. 199, the Charpy value

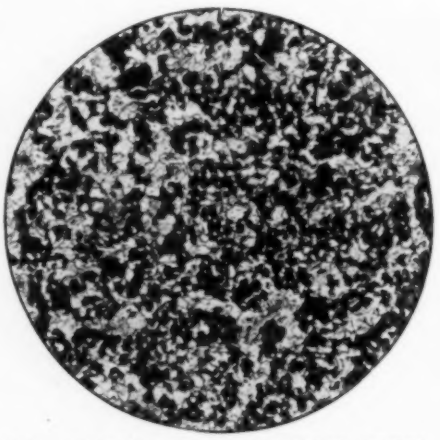


FIG. 6—MICROGRAPH OF CAST STEEL HEATED TO 900 DEGREES CENT., SOAKED FOR TWO HOURS AND FURNACE COOLED —X 50

was reduced to 8.49 foot-pounds, whereas heats Nos. 245, 292 and 304 with lower carbon and manganese contents showed mean Charpy values varying from 32.24 to 27.89 foot-pounds. Heat No. 239, with a carbon content of 0.44 per cent and a manganese content of 0.93 per cent shows a Charpy value of 10.01 foot-pounds. It would therefore appear that the shock strength of cast steel No. 3 can be increased by lowering the carbon content and increasing the manganese content. It also seems evident that any increase in the carbon above 0.30 per cent or in the manganese above 1.30 per cent decreases the Charpy value.

Figs. 2 and 3 are micrographs of material in pintle bearing, etched with nitric acid and magnified 50 diameters. Fig. 1 was quenched in water from 900 degrees Cent., and drawn four hours at 600 degrees. Fig. 3 was annealed 2 hours at 9500 degrees Cent., chilled in air, and drawn four hours at 500 degrees Cent. The composition was:

	C.	Mn.	Si.	S.	P.
Figs. 2 and 4 (*a*)	0.42	0.86	0.197	0.065	0.104
Figs. 3 and 5 (*b*)	0.42	0.86	0.197	0.065	0.043

Figs. 4 and 5 are micrographs of sections taken from pintle bearings poured from same heat of steel after being heated to 950 degrees Cent., chilled in air and drawn at 500 degrees Cent. Their compositions are identical with the exception of phosphorus. They were etched with Stead's reagent and magnified 50 diameters. Light areas show portions rich in phosphorus.

The experimental work on the heat treatment of acid open-hearth cast steel consisted of physical, chemical and microscopical tests of the heat-treated metal. The material consisted of slabs 1½ inch in thickness which were cut from a 10-inch round ingot.

Heat Treatment

Three heat treatments were applied namely:

Treatment A.—Heated to 900 degrees Cent., soaked two hours at this temperature and water quenched, followed by drawing two hours at 650 degrees Cent. and furnace cooled. Fig. 2 a microstructure similar to that of this material.

Treatment B.—Heated to 900 degrees Cent., soaked two hours at this temperature and furnace cooled. Fig. 6 shows the microstructure of this material.

Treatment C.—Heated to 950 degrees Cent., soaked two hours at this temperature and cooled in air, followed by drawing two hours at 500 degrees and furnace cooled. Fig. 3 shows a microstructure similar to that of this material.

The chemical analysis of the heat was as follows: Carbon, 0.30 per cent; manganese, 0.62 per cent; silicon 0.181 per cent; sulphur 0.038 per cent; phosphorus, 0.038. The physical properties are recorded in Table II.

From an inspection of the mean results of the tests it is evident that water quenching has raised the elastic limit approximately 10,000 pounds per square inch and the tensile strength 8000 pounds per square inch over that obtained by a simple furnace anneal. Furthermore, this has been accomplished with but little sacrifice of ductility. The shock strength, as measured by the Charpy impact strength, has been increased from 11.32 to 14.25 foot-pounds.

The air-chilled specimens show an increase in both elastic limit and ten-

(*Concluded on page* 519)

Air Furnace Is Fired Automatically

Coal Dumped Into a Hopper Which Feeds a Specially Designed Grate as the Coal Burns—The Only Manual Labor Necessary Is That Required For Pulling the Ashes

MELTING equipment for the foundry is decided by a number of factors. Gray iron which does not demand as close metallurgical control as does malleable iron and steel which is the cheapest melting medium, almost universally is melted in the cupola. A small amount of gray iron in which it is desired to have a low percentage of carbon is melted in the air furnace. On the other hand, steel requires a melting furnace which will allow the metal in the bath to be regulated and changed and controlled in its composition. Therefore, a more exact equipment than the cupola is required. A number of devices have been found adaptable, such as the crucible, the acid and the basic open-hearth furnace, the converter and the electric furnace. The air furnace is not used for steel melting because of the high temperature required by the steel and also because sulphur is taken by the metal from the flame which travels across the bath.

These two objections to the use of the air furnace do not hold in the case of malleable iron. The temperature required is not so high as when steel is melted and the sulphur content may be kept within the bounds necessary. As the cupola can be used for melting malleable only when a strong ductile metal is not demanded, the air furnace has secured a dominant position in the malleable industry. In this field its position is encroached upon only slightly by the cupola. Recently a combination of the cupola for melting, the converter for decarbonizing part of the metal and the electric furnace for relining has been operated by one malleable iron company.

While the air furnace has been in use a great many years in the malleable industry a number of

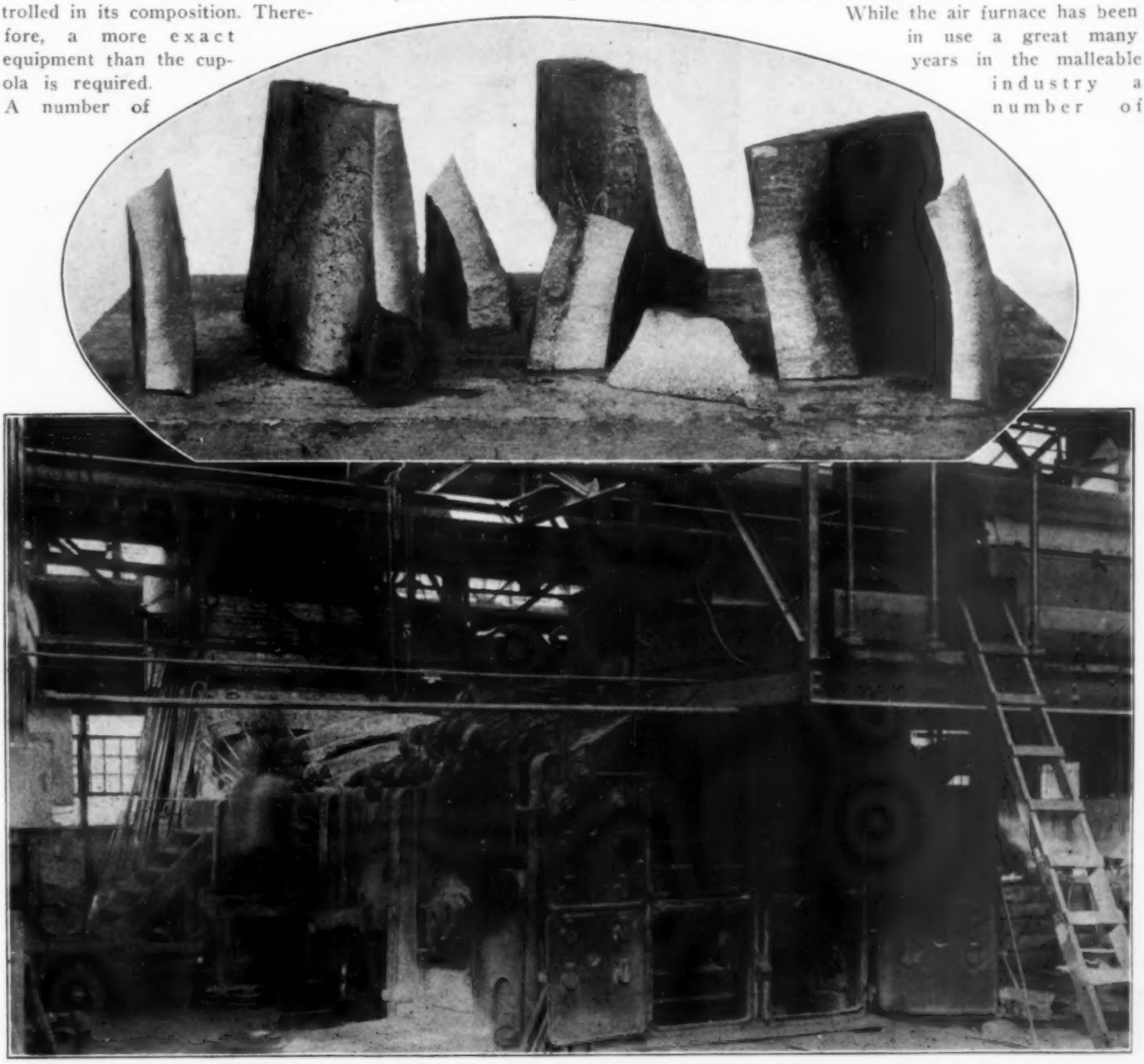


FIG. 1—BELOW THE FIRING END OF THE MALLEABLE IRON MELTING FURNACE ABOVE SAMPLES OF BROKEN LINERS INDICATE THE DEPTH OF THE CHILL

FIG. 2—METAL IS CHARGED THROUGH THE TOP AFTER THE BUNGS ARE REMOVED IN THE MANNER SHOWN

changes have been made recently to overcome the handicap given to this furnace by the old method of firing with coal. This formerly was the almost universal method of heating the air furnace. However, some installations were made a few years ago for using fuel oil, and this method is still employed by some firms, although the price of oil makes it more expensive than coal firing, under ordinary circumstances. After powdered coal had proved its adaptability for annealing malleable castings, it was tried in the melting furnaces and some firms which have tried it on one of their furnaces, at the start, later have equipped more units with it.

The main advantage claimed for oil firing and for the use of powdered coal is the saving in manual labor which is arduous in hand firing with coal. A more recent method for firing the air furnace has been adopted by the Allis-Chalmers Mfg. Co., which has installed a small air furnace in its hard-iron foundry. This foundry casts in chills iron which is approximately the same composition as malleable iron. The furnace, shown in Figs. 1, 2 and 3, is of about 15 tons capacity. Two heats are poured each day making a total of 55,000 pounds of metal.

The main characteristic of this furnace is the firing system. A hopper shown to the left above the furnace, *A*, Fig. 2, is placed over the fire box. This fire box is fitted with a special grate built like a stairs with the riser, or space between the treads, left open. The grate is shown in Fig. 1, before the coal had been put in for a heat. To start the heat, kindling is placed on the grate and a fire is started. The doors of the firing chamber are closed and

FIG. 4—THE TRUCK IS PROVIDED WITH A SCALE PLATFORM FOR STOCK

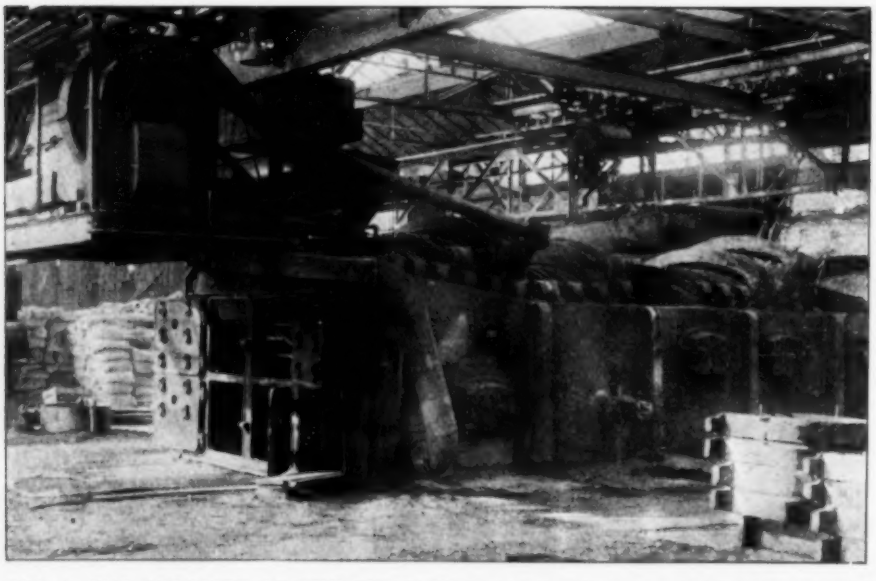


FIG. 3—THE OPPOSITE OF THE FURNACE FROM THAT SHOWN IN FIG. 2—NOTE THE COMPACT FIRING ARRANGEMENT

coal is charged by dumping it into the hopper above the furnace. This is done by a hand controlled electric crane which lifts a box of coal above the hopper. The coal is dropped by releasing the drop bottom which is held with a catch hook. Falling upon the grate it automatically banks up but does not fall through the riser because the treads extend partly under each other and form retaining shelves. The fire-box holds 1000 pounds of coal.

Small holes covered with hinged plates may be noted on the firing chamber doors. These provide access through which to poke the ashes from the grates as the coal burns away. More coal then falls automatically on the grate to fill the space left by the ashes which has been pushed into the pit beneath. In this way, practically no manual labor is required in firing the furnace. Otherwise, the furnace is

much like other air furnaces. Forced draft is furnished underneath the grate and through the roof by a fan located on a steel platform at the rear of the furnace. This fan with the pipes leading from it is clearly shown in Fig. 3. A tapping hole is located on each side of the furnace. Metal is charged through the top after the bungs are removed. Sprues are charged in much the same way as coal that is by the crane in drop-bottom boxes. Pig iron is charged by hand, as will be explained.

White-iron and chilled castings are made from the metal which is much the same composition as malleable iron. The superintendent of this foundry has entire supervision of the iron. When pig iron is received each car is placed on a separate pile and a sample is sent to the laboratory for analysis. No iron is used before its composition is known. The mixture is made of a large proportion of charcoal pig iron together with coke pig iron and sprues from the foundry. A storage-battery truck carries the metal from the stockyard to the foundry. This truck has a scale platform so that the correct amount of pig iron may be loaded at the stock pile. A load of iron is shown in Fig. 4. This is carried to the furnace and the four-legged stand on which the pig iron sits is lifted to the platform shown at the side of the furnace, Fig. 1. Here the iron is about level with the top of the wall of the furnace and it only requires a few minutes to throw in the small amount needed in a heat.

The metal is cast into liners and concaves which fit into rock crushers and into grinders for cement mills. Crusher heads for rock crushers are cast in one piece with a core for forming a hole for the shaft. However, the liners are cast in sections. All the castings mentioned must have an extremely hard surface which is secured by casting the metal against chills. Balls for cement mills also are cast from the same iron but they are so small that with the grade of iron used they become white iron without the use of chills.

The amount of silicon put into the metal depends upon the section of the castings to be poured. The small balls and thinner liners are cast on days when a heat of the higher silicon metal is made, and a low-silicon metal is poured into the heavier liners and the larger diameter balls. The composition of the metal must be closely regulated to suit the section of the castings to be poured as a deep chill is necessary to give a casting with a long life, but an entirely white liner would be too brittle. Samples of broken liners shown in the inset, Fig. 1, indicate the depth of chill. It is interesting to note that the Allis-Chalmers Co. has made extensive tests of chilled iron in comparison with manganese steel and finds the wear on the two metals to be about equal under similar conditions. However, a manganese-steel casting can be worn further than an iron casting as the latter becomes brittle and cracks when worn thin.

With the manufacture of such a large quantity of chilled iron castings as the Allis-Chalmers company produces the life of the chill presents a considerable economic problem. The company now is making a study to determine the best grade of metal to put into the chills to prolong their usefulness. In car-wheel work an iron containing a small percentage of steel and low in silicon phosphorus and combined carbon near 1 per cent has been found to give good results. Possibly the experiments now being conducted at the Allis-Chalmers plant in West Allis will confirm these conclusions, or they may show a different metal to be preferable.

Installs 6-Ton Jar-Ram Rollover Machine

SUCCESSFUL accomplishment with the jar-ram, rollover patterndraw type of molding machine induced A. N. Kelley formerly superintendent the Modern Foundry Co. located at Oakley, a suburb of Cincinnati, recently to install a larger machine than any previously operated in this foundry. The new machine fits in with the arrangement of the shop described in THE FOUNDRY of May 15, 1920. It is located at the head of the molding bay and the sand is brought to it from the shake-out bay in a gondola car operating on a standard-gage track. The machine, which will handle any mold section up to 6 tons in weight was made by the Osborn Mfg. Co., Cleveland. It is located on a concrete pier in a pit, 11 x 16 feet and 9 feet deep, lined with concrete. The pit is covered with a wood platform and only a small portion of the machine protrudes above the platform, as may be noted in the illustrations. Cast-iron plates are used for all patterns, it has been found that the iron flasks soon cut into plates made of wood and under such conditions the thickness of the casting is increased. The plates which are 1½ inches thick and heavily ribbed are cast in open sand and the tops are then planed smooth for receiving the pattern.

The table of the machine is 69 inches wide and 106 inches long between sockets. The length of the pattern plate, which can be operated on the machine, is limited to the length between the sockets but plates slightly wider than the table can be handled.

Fig. 2 shows a flask on the machine being filled with sand. The sand is brought by a crane from the flat car near by, in the grab bucket shown. The crane operator controls the jaws

FIG. 1—THE MOLD HAS BEEN CARRIED AWAY BY THE BUGGY AND THE PATTERN IS READY FOR ANOTHER MOLD

of the bucket to pick up the sand and to drop it. This illustration shows the herring-bone cross bars used in the Modern foundry. These are arranged at such an angle that they slope about one inch to the foot and so serve to relieve shrinkage strains caused by con-

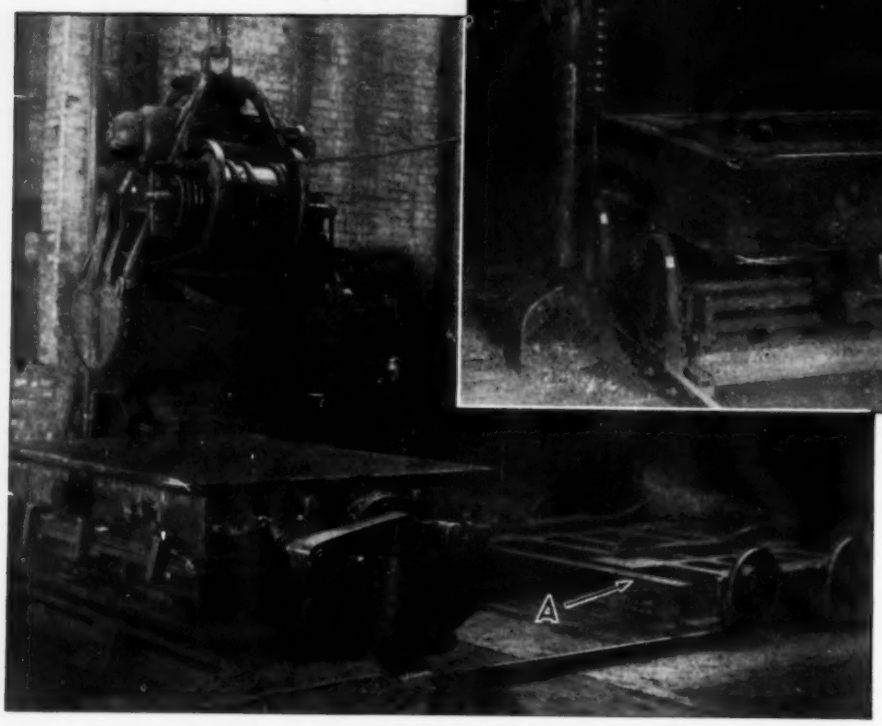


FIG. 2—SAND IS CARRIED FROM A GONDOLA CAR TO THE MOLD IN AN ELECTRICALLY OPERATED BUCKET—NOTE THE HERRINGBONE BARS IN THE FLASK

traction and expansion of the flask through heat effects. The drag flasks as well as the copes are fitted with cross bars, as bottom plates are not used. The flask joints all are planed and holes for dowel pins are drilled with templets, so that copes and drags are interchangeable and it is not necessary to have a particular cope for each drag. In this way all the drags on an order can be made, then the pattern is changed and the copes are made. After they are dried the copes can be put on the drags indiscriminately.

The jar-ram cylinder is operated by air under 80 pounds pressure, raising the table approximately 1½ inches. Jarring is continued 1 to 1½ minutes. The mold is finished by ramming with pneumatic rammers and the excess sand is scraped off. The table then is raised by air pressure and turned. The power-driven, mold-carrying carriage, shown in the illustrations is pulled under the mold by two wire cables attached to each side of the carriage and to a rotary air hoist located beneath the platform. The travel of the carriage is limited at both ends by automatic stops. The bar *A*, Fig. 2 strikes the sand off the jolt table of the machine as it passes over it. This takes off the bulk of the sand and the last portion is blown off with an air hose. The mold then is set on the carriage and the pattern is drawn by raising it as shown in Fig 3. The carriage is then pulled back and the pattern turned and set on the jarring table as indicated in Figs. 1 and 4. These illustrations show the guards on each side of the wheels adapted for clearing the tracks of sand. The pattern, shown on the machine in Fig. 1 is a column for one of the larger milling machines which could not be molded on the machines in the shop before

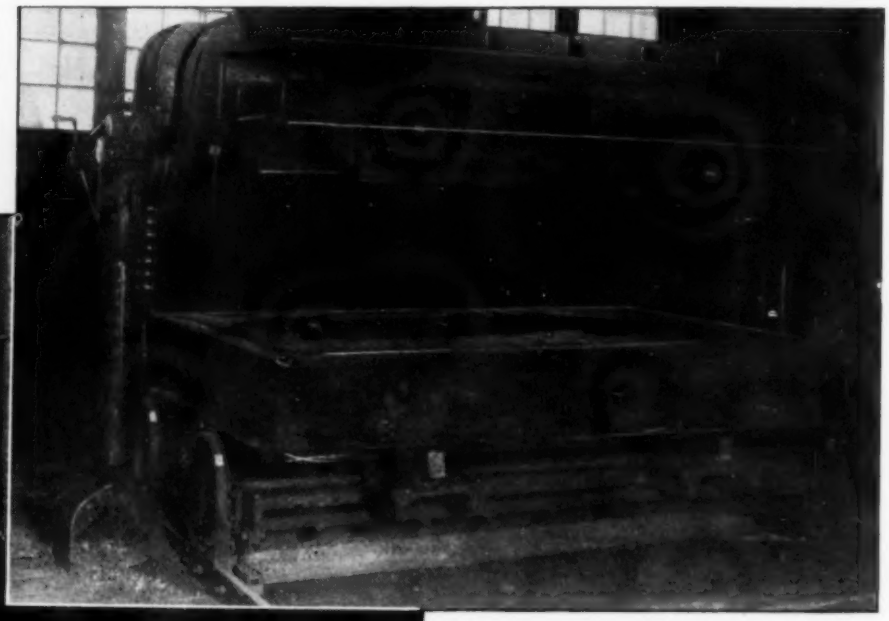


FIG. 3—WHEN THE FLASK IS ROLLED OVER ON THE TABLE THE PATTERN IS DRAWN BY THE MACHINE

this large one was installed. Fig. 4 shows a pattern for a smaller column on the machine. As the top of the flask must be a fixed distance above the face of the jarring table, to allow it to be set in the mold-carrying carriage, flasks shallower than the standard of 18 inches are raised by filler plates or by variation in the depth of the ribs beneath the pattern plate.

Castings for milling machines such as the company makes usually are symetrical, so that the patterns can be split and half molded in the drag and half in the cope, which makes them adaptable for use on this type of machine. The castings also must be uniform to fit jigs in the machine shop and to be lined up, a number on the same planer or milling machine. It has been found that, with accurate flask equipment, the jar-ram machine produces more uniform castings than were formerly made with pneumatic or hand ramming, and less experience is required on the part of the molder.

FIG. 4—SHALLOW PATTERNS MUST BE RAISED BY FILLER PLATES OR BY DEEPER RIBS ON THE PATTERN PLATE

Place Cupola on a Weight Schedule

The Charges Are Placed in the Furnace in a Definite Order and by Observing the Same Order in Tapping the Iron Can Be Controlled Closely

BY H. M. LANDGRAF

IN JOBBING foundries where a large variety of miscellaneous work is done it is necessary to provide different grades of iron to meet the requirements of the many classes of castings involved. The question of providing an iron to meet a definite specification and analysis is of the utmost importance since these factors exercise a definite influence on the comparative density and machineability of the resulting casting. Placing the different mixtures in the cupola only solves half the problem. It is just as essential that the foundryman knows when each kind comes out the tap hole.

It is not always easy to determine just when one kind of iron stops and where another begins especially if a special charge has been preceded by several ordinary charges and if it is followed by several charges of the same character. For this reason it is customary with the majority of foundrymen to run their special iron either at the first or last part of the heat. This method is not always practicable from a production standpoint. The problem becomes still more complicated when it is necessary to melt not one but several grades of iron during the one heat.

The accompanying illustration shows the routing board installed in the gray iron foundry of the Chain-Belt Co., Milwaukee. A large variety of castings, many of them requiring to be poured with special iron are made in this shop. It will be noted that the chart calls for a certain quantity of iron to be drawn off at each tap. The weight of metal to be drawn off each time is determined by calibrated ladles. The capacity of all the ladles has been measured. A bent wire with one end attached to a float and the other end registering on a scale on the outside of the ladle indicates the amount of iron in the ladle at any time. When the required amount of iron is in the ladle it is routed to the proper floor or section of the foundry where the iron then is distributed to the hand and bull ladles. In the case of the crane ladle it is taken to the particular section to which it has been routed and used to pour the castings that have been on that floor.

It will be noted that where the quality of the iron changes the division point is well defined by interposing a quantity of separator iron. This of course is only possible because a known quantity of metal previously has been drawn off and the amount tapped off is in exact proportion to the amount originally charged into the cupola. The sequence of charging must be planned in advance to meet the tapping schedule and posted on a blackboard on the charging platform.

TAP OFF POUNDS
LADLE
KIND OF IRON
FLOOR
3000 Crane Ladle CHILLED IRON D
2500 Crane Ladle Separator Iron E
2400 Truck Ladle Semi Steel E
2400 Truck Ladle Semi Steel A
2400 Truck Ladle Semi Steel F
2500 Truck Ladle Semi Steel F
2400 Truck Ladle Separator Iron F
2600 Truck Ladle Soft Iron F
2500 Truck Ladle Soft Iron F
2600 Truck Ladle Soft Iron F
2300 Truck Ladle Soft Iron F
2700 Truck Ladle Soft Iron F
TOTAL HEAT

TYPICAL CHART INDICATING THE MANNER IN WHICH THE DIFFERENT GRADES OF IRON ARE KEPT SEPARATED

The iron referred to as separator iron comprises what has been left of one charge and some from the beginning of another. It is used for pouring a class of castings which do not have to meet certain specifications. Drawing this ladle off between mixtures will insure that the following ladlefull will be of uniform quality. It is quite apparent that the foregoing method may be used to advantage where it is necessary to drop in special charges at separated points during the heat. The important point in connection with the method is to plan the heat carefully in advance and lay out a charging schedule which must be followed. Having done that it is relatively simple to plan the tapping of the heat in such a manner as to draw off iron of a known quality and analysis all the time.

Study Impact Tests on Cast Steel

(*Concluded from Page* 514)

sile strength of approximately 3000 pounds per square inch over that obtained by a simple furnace anneal. This increase is in good agreement with what has been observed in the foundry annealing practice on No. 3 steel castings. The Charpy test also shows slight improvement.

In view of the fact that every one is not thoroughly familiar with the results obtained upon the Charpy impact machine, the following data obtained upon forged steel bars are submitted for the purpose of comparison with results on cast steel. The results given in Table III were obtained from specimens cut from bar stock approximately 1 inch in diameter, after various heat treatments. The table also shows the composition of the several bars as well as the heat treatment to which each was subjected and the results tabulated.

Aluminum-Alloy Melting Loss Great

Description and Estimation Given of the Losses Sustained in Melting Aluminum and Aluminum Alloys—Oxidation and Heavy Fuel Consumption Due to Inefficient Furnace Operation Principal Causes

BY ROBERT J. ANDERSON

MELTING losses are a serious source of financial loss in brass and bronze practice, but they are especially serious in the case of aluminum and its light alloys because of the relatively high price of aluminum. The fact that the oxidation losses in melting aluminum and its light alloys are high is well known, but it is doubtful whether the factors governing the most suitable methods of melting for a minimum of dross are equally well known. The metal losses involved in melting are worthy of especial attention now because of the rapidly growing importance of the aluminum industry.

The essential requirements in the commercial melting of any metal or alloy are that the melting losses and melting cost should be low, and the melting should be rapid. Certainly it may not be possible to obtain these requirements in any furnace selected at random, and it follows that the design and the operation of furnaces for melting different metals are subjects that warrant the most extensive study and tests. As a general rule, in the industrial operation of furnaces, run on aluminum and aluminum alloys, an effort is made to keep the dross and oxidation losses as low as possible. In attempting to hold dross losses low, numerous factors involved in metal melting may be overlooked, or at least disregarded, and the net practical result may be that the furnace is exceedingly wasteful of fuel. In the case of aluminum and its light alloys, the effect of increasing the temperature of melting, at least in an atmosphere containing free oxygen and nitrogen, is to increase the net melting loss.

While a great many factors are attached to the operation of any metal-melting furnace, the most important with regard to their bearing on dross losses in the melting of aluminum and its light alloys are probably the type of furnace employed; the melting temperature; the length of time required for melting and superheating to the pouring temperature; the length of time during which the metal is allowed to remain in the furnace after reaching the pouring temperature, that is, the soaking period; the constitution of the furnace atmosphere in contact with the metal, which is governed, of course, by the type of furnace, method of firing, and the fuel used; and the volume of air and products of combustion passing over the metal per unit of time. These and other factors governing furnace operation and dross losses as applied to the melting of aluminum and its light alloys deserve careful attention.

From a report prepared for the United States bureau of mines. The author is connected with the experimental station at Pittsburgh.

Principal Factors

Many factors also vitally influence the fuel consumption in melting, but it is sufficient here to point out only a few of the more important ones. These include the furnace design with relation to the combustion space; air supply; fuel used; relation of fuel supply to air supply; design of burner; and method for removing waste gases. On the whole, not a great deal of thought has been given to the design of furnaces especially intended for melting aluminum and its light alloys, but since the factors governing the melting of this metal are in some definite respects peculiar to it, anl since both the fuel and metal losses in industrial practice are high, the entire subject evidently requires the most careful study.

At the present time, the selection of the correct type of furnace for a given set of operating conditions is made especially difficult by the multitude of different types of furnaces extant and, more particularly, by the lack of comparable data regarding each one. Also the selection of a furnace is governed by the requirements of the plant. Therefore, it is not possible to state that there is any one best furnace. In general, the melting of aluminum alloys in foundry practice has followed along the general lines of brass melting, probably because these alloys have been cast largely in brass shops. Light aluminum alloys are, or have been, melted in all types of furnaces that have been used for brass and bronze. The iron-pot furnace, so widely used for the melting of so-called white metals, is the only furnace employed for aluminum alloys that is not used for brass and bronze.

The type of furnace used depends upon whether aluminum or one of its light alloys is being melted, as well as whether, if aluminum, the metal is melted for repigging or for casting into rolling ingots, and, if light alloys, whether they are to be poured into sand castings or used for the production of die or permanent-mold castings, or are poured into rolling ingots. The smelting of aluminum-alloy borings and related aluminum-bearing scraps presents a distinct problem, and various types of furnaces are used commercially for this purpose.

It is in light-alloy foundry practice that the greatest variety of furnaces are found. The following types of furnaces are at present in daily use in the aluminum foundries of the United States; gas and oil-fired reverberatory furnaces; gas and oil-fired stationary and tilting iron-pot furnaces; coal and coke-fired, natural and forced-draft pit furnaces; gas and oil-fired stationary and tilting crucible furnaces; gas and oil fired stationary, rotating, and tilting open-flame furnaces; and electric furnaces of different types. The stationary and tilting iron-pot furnaces are favored considerably in the United States, particularly by large foundries, but open-flame furnaces of different designs are being used more widely than a few years ago. In small foundries, and in foundries where aluminum alloys form only a minor part of the output, pit or crucible furnaces are used largely. Electric furnaces for melting both aluminum and its light alloys are just now receiving considerable attention, and a few installations have been made. The tendency in recent years toward the use of furnaces of large capacity—namely, reverberatory furnaces, open-flame barrel-shaped furnaces, and electric furnaces—has come through the enlargement of plant capacity. Where a foundry is turning out 5,000,000 to 10,000,000 pounds of finished castings per annum, melting in units of small capacity requires a large installation, that is, many furnaces. One type of barrel-shaped open-flame furnace can melt at least one ton of metal per hour, and the advantages to be gained in operating units larger than stationary crucibles or iron pots are apparent in foundries where the daily output runs up to thousands of pounds.

In modern aluminum-alloy die-casting practice, the alloys are melted in

small cast-iron pots which may be considered as part of the die-casting machine proper. The fuel is usually gas. In both die casting and permanent-mold casting, it is standard practice to make up the alloys in an alloying furnace and run them into small pigs. The prepared alloys are then remelted for casting. In permanent-mold casting practice, small iron pots fired by gas are preferred for melting the alloys prior to casting.

Practice Not Standardized

In the smelting of aluminum and light aluminum-alloy borings, scraps, and drosses, domestic practice is not standardized, and several different types of furnaces are employed commercially. For smelting borings and other light scraps for the production of so-called "casting aluminum" and in making secondary aluminum alloys, the following types of furnaces are employed commercially; stationary iron pot furnaces, reverberatory furnaces, pit furnaces, and open-flame tilting-and-rotating furnaces.

Using the figures for 1918, which was the year of greatest output and consumption of aluminum in the United States, the domestic output of primary metal was 225,000,000 pounds. The recovery of secondary aluminum as such or in the form of alloys, in the same year, amounted to 30,100,000 pounds.

The average recovery from light-alloy borings and related scraps is 65 to 70 per cent. The total amount of borings may be taken as 15 per cent of the casting production; with the latter at the rate of 81,000,000 pounds per annum, the total amount of borings available for melting is 12,150,000 pounds. The average recovery from furnace dross, containing 30 to 60 per cent metallics, may be placed at not more than 80 per cent of the contained metal. With 40 per cent metallics in the dross, and assuming that 4,500,000 pounds of such dross is available for smelting, the total amount of available metal is 1,800,000 pounds. The total amount of aluminum in various forms melted in the United States (1918 basis) may then be considered as at least 238,950,000 pounds, if no account be taken of exports and imports. The exports are much less than the imports, and the latter are estimated as equal to about 10 per cent of the domestic production. On this basis it can be estimated that at least 250,000,000 pounds of aluminum in various forms is now melted in this country.

All aluminum is melted at least twice and much of it several times, considering a given unit weight of metal. All primary metal from the reduction cell is remelted and cast either into pigs or into ingots for rolling or other working. All primary aluminum for the manufacture of alloys is remelted in the foundry or elsewhere when alloys are made. Some secondary aluminum is used in the make-up of charges for the production of rolling ingots, and a considerable amount of secondary aluminum-alloy pig and light alloy foundry scrap is used in most foundry charges. It may be stated conservatively that the primary and secondary aluminum used is melted at least twice; there is a melting loss each time.

In distinguishing between aluminum melting practice and aluminum-alloy melting practice, it is necessary to point out that about 50 per cent of the domestic consumption of aluminum is used as such, while the remainder is employed in making light aluminum alloys. Knowing the amount of aluminum and aluminum alloys melted and the average melting losses, it is possible to arrive at a figure for the annual monetary losses.

The actual loss of metal due to oxidation, that is, the so-called dross loss in melting aluminum and its light alloys is large. On the basis of data reported by operating companies to the bureau of mines and from figures derived from actual tests and from other sources, the gross loss of metal resulting on melting substantially pure aluminum may be taken as not less than 2 per cent, although extreme figures of 0.75 and 5 per cent have been reported. This refers to the melting of aluminum for casting into rolling ingots, and it may be taken as an average figure for aluminum on the basis of average rolling-mill charges. The average net loss resulting on melting substantially pure aluminum may be taken as not less than 1.25 per cent, on the basis of reported figures, allowing for the recovery of mechanically entangled metal from the dross. If dross be considered to contain 40 per cent metallics on the average, the net loss on this basis would be 1.20 per cent (assuming perfect recovery) which agrees well with the figure given here. If it be considered that the metal is melted twice, then the average net loss of 1.25 per cent is equivalent to 2.50 per cent for all the aluminum used as such.

In the same way, the gross loss of metal resulting in melting for the production of alloys in foundry practice may be taken as 4 per cent, on the basis of figures reported to the bureau of mines, although extreme values of 1 and 8 per cent have been given. This refers to melting in a variety of different types of furnaces. The average net loss in the melting of alloys in foundry practice may be taken as 2.5 per cent on the basis of reported figures. If the dross be considered to contain 40 per cent metallics on the average, the net loss on this basis would be 3 per cent; this does not agree well with the figure given in the previous paragraph. The figure 2.5 per cent for the net loss will be used here. If it is considered that the metal is melted twice, then the average loss of 2.5 per cent is equivalent to 5 per cent on the gross melt.

In regard to the fuel losses in melting aluminum and its light alloys, it may be said that in general the fuel efficiencies obtained in average practice are extremely low. The fuel consumption in melting auminum and aluminum alloys is about twice that used in melting brass and related alloys, owing to the high specific-heat and high latent heat of fusion of aluminum. Theoretically, if all of the available heat units in a fuel were utilized —that is, if the furnaces were operated at 100 per cent efficiency—it would require the following approximate amounts of fuels to melt 100 pounds of aluminum and superheat it to 800 degrees Centigrade for pouring: 4 pounds of coal or coke; 2.7 pounds or 0.35 gallon of fuel oil; 57 cubic feet of natural gas; 86 cubic feet of illuminating (city) gas; or other fuels in proportionate amounts. However, in practice tremendous amounts of fuel in excess of the theoretical requirements are consumed. The actual limits of fuel consumption in melting light aluminum alloys in foundry practice, as reported to the bureau of mines, are as follows: 50 to 200 pounds of coal or coke; 0.54 to 15 gallons of oil; and 150 to 1000 cubic feet of natural or artificial gas. It is doubtful whether the fuel efficiency in furnaces melting aluminum and aluminum alloys can be, on the average, more than 5 per cent of the theoretical efficiency. It is difficult to estimate the monetary values of the fuel losses, but sufficient has been said to show how serious they are.

Melting Loss

Turning now to the question of the monetary losses incurred in aluminum and aluminum-alloy melting practice in the United States, figures have been derived for these values as applied to present commercial practice in the United States. In the consideration of net losses in melting, it was stated that the loss in melting aluminum is 1.25 per cent and in melting aluminum alloys is 2.50 per cent. Since the melting is considered to be performed at least twice, then the net losses are 2.50 and 5 per cent, respectively, on the gross

melt. On the basis that 50 per cent of the aluminum consumed in the United States is used as such, and that 50 per cent goes into the production of aluminum alloys, the following figures were obtained.

Total consumption of primary aluminum (a)	225,000,000
Total aluminum used as such	112,500,000
Total aluminum used for alloys	112,500,000
Net loss in melting aluminum (b)	2,812,500
Net loss in melting aluminum alloys (c)	5,625,000
Total loss	8,437,500

(a) On the basis of the domestic production in 1918.
(b) Net loss, 2.5 per cent on the gross melt.
(c) Net loss, 5.0 per cent on the gross melt.

Allowing for extra meltings, and on the basis of the above estimate (1918 basis) of 250,000,000 pounds of total aluminum, melted as such or in the form of alloys, it may be stated conservatively that the net loss is about 9,000,000 pounds of aluminum per annum, on the basis that all of the metallics of the dross and skimmings are recovered. Since the recoveries in smelting dross, borings, and other aluminiferous scraps are never perfect, and often quite low, it is evident that the net loss must be higher than the figure just given. However, the figure of 9,000,000 pounds may be taken here.

On the basis of a $0.33 metal market for primary aluminum, the total monetary loss may be considered to be $2,970,000 per annum. Setting aside any consideration of the additional losses in melting owing to furnace inefficiencies, overhead, and labor charges, it is evident that if the present net losses could be reduced 50 per cent a saving of about $1,500,000 would accrue. Probably $2,000,000 yearly could be saved if the fuel and other losses were considered on the basis of similar improvements. However the calculations be made, it is certain that if the average practice were raised to the standard of the best practice, great savings, at least of the order of those indicated above, would accrue to the aluminum industry of the United States. From a monetary standpoint, it is certain that the study of melting practice for aluminum and its light alloys is one of especial importance, and the selection of melting equipment is a subject which warrants the most extensive study and tests. The statistics used above for the domestic consumption of aluminum are for 1918, which was a war year when the consumption was the heaviest in history. Since that year, a considerable slump has occurred, and the present losses are not so large as those given. However, the order of magnitude is sufficiently accurate to convey the idea that the losses involved are serious and that every effort should be made to reduce them, at least to a reasonable figure.

How and Why in Brass Founding

By Charles Vickers

Conversion Method for Figuring Alloys

Will you please outline a short way of figuring mixtures, in changing one alloy to another.

An excellent method of converting alloys was described by W. W. Rogers in a paper, "The Care and Conversion of Rolling Mill Scrap," presented before the American Institute of Metals at its convention in Chicago in 1914. The following illustration taken from this report will explain this method. A 10 per cent nickel silver is converted into an 18 per cent nickel silver as follows: The composition it is desired to convert is placed on the left of the paper, the alloy required on the right, as follows:

	Composition of 10 per cent scrap	Composition of 18 per cent scrap
Copper	60 per cent	62 per cent
Nickel	10 per cent	12 per cent
Zinc	30 per cent	20 per cent
	100 per cent	100 per cent

Next, select in the left column, the constituent that has the greatest excess over any similar one in the right. In this case it is manifestly the zinc, viz., 30 per cent in one case and 20 per cent in the other. Now multiply the 20 per cent by 100 and divide by 30.

$$\frac{20 \times 100}{30} = 66.66$$

This figure is the amount of scrap to be used in 100 pounds of the required alloy, and this quantity contains the necessary amount of zinc.

In order to discover the requisite amount of copper to be added, calculate the amount of copper in 66.66 pounds of the 10 per cent nickel scrap as follows:

$$\frac{66.66 \times 60}{100} = 39.996$$

This is practically 40 pounds. Subtract this from the percentage of copper in the 18 per cent German silver required in the right column.

$$62 - 40 = 22$$

and you have the amount of copper required.

Proceed in the same manner for the nickel.

$$\frac{66.66 \times 10}{100} = 6.666$$

Subtract this from the percentage of nickel in the 18 per cent nickel silver required,

$$18 - 6.66 = 11.334$$

which is the amount of nickel necessary to complete the required alloy.

Now add up what is found as follows:

66.666	pounds of 10 per cent scrap, containing the zinc required
22.00	pounds of copper
11.334	pounds of nickel
100.000	Total

This makes 100 pounds of the required alloy The same method can be used to change any alloy, and with a little practice can be done rapidly.

Melting Aluminum Bronze

We are melting aluminum bronze in a revolving oil-fired furnace and the flame plays directly on the metal. As a consequence our melting losses are high, being 20 per cent with this furnace, while with crucible melting it will be about 1 per cent. We would like to discover what covering it is best to use, as a mixture of soda, ash, borax, charcoal and coke dust are of no use, the compressed air blowing them off. We have also used salt, 85 per cent, and fluor spar, 15 per cent, with little success. Can you inform us what covering to use? The alloy consists of copper, 89 per cent; aluminum, 10 per cent; manganese, 1 per cent, with a trace of iron.

To produce aluminum bronze successfully from the type of furnace mentioned it will be necessary to reduce the air supply or to increase the oil until a slightly reducing flame is obtained and it will require longer to melt the copper. Under these circumstances it will not be necessary to apply a covering, but a few lumps of charcoal or hard wood would improve the melting conditions. No flux of any kind can be used in making aluminum bronze, because at the temperature of molten copper the aluminum will attack the flux and reduce therefrom some element which will enter the bronze and produce *wormy* castings in sand molds.

Fluor spar is especially bad. If a reducing flame is used to melt the copper, then the manganese addition is made, then a flux of dampened sawdust mixed with manganese chloride is added, for a few minutes before the aluminum is added, better success will be attained. In making aluminum bronze it is highly important the copper be not oxidized before the aluminum addition is made; otherwise a heavy loss of aluminum and formation of alumina, which will be held by the bronze and produce dirty castings will result. The bronze must be clean in the first place, but remelting it is not so important, as it is the oxides produced within the metal that do the most harm.

Nickel and Copper Alloys

We desire information regarding the casting of nickel-copper; the rolling of the alloys into sheets; annealing, pickling, cutting, and manufacturing into coins. We would feel favored to receive from THE FOUNDRY *advice as to where this information can be obtained.*

Information on the subject of nickel-copper alloys is meager. There are no books that we are aware of on the subject. What little information is available is scattered throughout the Transactions of Societies dealing with metals.

In the transactions of the Institute of Metals (British) the following papers can be found:

The Annealing of Coinage Alloys, Vol. VIII. No. 2, 1912. The Annealing of Nickel Silver, Vol. XV. No. 1, 1916. The Annealing of Nickel Silver, Part II, Vol. XVII, 1917.

On Graphite and Oxide Inclusions in Nickel Silver, Vol. XXII, No. 2, 1919.

These volumes can be obtained from the Secretary of the Institute of Metals, 36 Victoria Street, Westminster, S. W. I. England. Price each, 31½ shillings.

In the Transactions of the American Institute of Mining and Metallurgical Engineers will be found a paper entitled, "Physical Properties of Nickel." This can be obtained by application to the Secretary, 29 West 39th Street, New York City.

Using Old Scrap Mixtures

We are having difficulty with pin holes in aluminum castings which are made from metal that has been spoiled by inexperienced help. There is about two tons of this metal and we would like to learn what to do to use it up. We have also about the same amount of old brass lying around, that has been all mixed up with old copper wire, and with yellow brass. In addition we have on hand ingot brass of inferior grade which when made into castings, produces spongy castings. We have used it in the proportion of about 75 per cent ingots, 25 per cent copper, when the castings are free from porosity, but we do not know what composition the brass may be.

The only suggestions possible without actually seeing the scrap is to use the spoiled aluminum in admixture with new aluminum alloy, the proportions of each being found by experiment. Thus possibly if half scrap and half new alloy is melted together the castings will be free from the pinholes. These latter usually are caused by pouring the aluminum too hot into the molds. If the mixed scrap brass has been picked over until it is not possible to separate any more metal that can be recognized as copper, or as brass, the best thing would be to clean it of iron, then melt it into ingots. These latter then may be used in the same manner as the inferior ingot brass is being used. Concerning the latter, it would be well to continue the admixture of copper. No doubt this ingot carries as much zinc and lead as possible, and the addition of more of these metals would not be advisable. However, if there is complaint about the castings being difficult to machine, add about 3 pounds of lead to the mixture, and if they come porous, and the alloy looks coppery, add the same amount of zinc. It is more economical to use new metals, in connection with ingot metal of known analysis in the long run, than to attempt to make castings from such heterogeneous scrap.

Aluminum Will Alloy With Nickel and Copper

We wish to learn if it is commercially feasible to produce an alloy of aluminum containing nickel to the extent of from 3 to 5 per cent, or an alloy of these constituents substantially in the proportions stated, whereto a small percentage of iron has been added? We are informed by manufacturers of such alloys that such an alloy probably could be made, but that it would not roll, because of its lack of malleability. Also the cost of production would be prohibitive, as only one or a dozen batches could be rolled into sheets, the remaining batches being unfit for use. We believe that these results might be attributed to the hardening propensities of the nickel, which when added to aluminum, forms a rather stringy substance, not having the proper consistency for rolling. Any information you may be able to give will be appreciated.

It is entirely feasible to make nickel-aluminum alloys within the limits mentioned, while alloys up to 4 per cent nickel, or 2 per cent copper, 2 per cent nickel, roll perfectly and they can be drawn into wire 0.033 inch in diameter without cracking or they may be hollow drawn. In regard to making the alloy, all that is necessary is to first make a *hardening alloy* of nickel and aluminum, in the same manner as alloys of copper and aluminum, 50 per cent of each are used to produce copper-aluminum alloys. An alloy of aluminum with 7 per cent nickel is being produced by one concern. The above remarks regarding nickel-aluminum alloys are not based on private opinions, but on well proved facts. More complete particulars regarding these alloys can be obtained from Circular of the Bureau of Standards, No. 76, entitled Aluminum and its Light Alloys. This publication can be obtained from the Government Printing Office, Washington, D. C., price 20 cents. We refer to page 47 for information in regard to alloys of aluminum and nickel.

Sand Causes Trouble

We have had considerable trouble with our brass molding, and so far have failed to locate its source. We have been using the same sand for both iron and brass castings, and have wondered whether, or not, this could be the cause.

It depends on just what the difficulty may have been. If the castings of brass come out of the sand with objectionable coloring, it might be due to the facings used next to the patterns when molding for iron. If the trouble comes from spongy castings, it is not due to the sand. The mere fact that the iron castings come out of this sand without defects, proves the innocence of the sand, for the melting point of cast iron is 2228 degrees Fahr., and that of bronze 1690 degrees Fahr., the pouring temperature of the former metal being higher. If the sand withstood the heat of the cast iron and produced smooth castings, it would easily do the same for the bronze. If any iron accidentally gets into the bronze while it is melting, the castings will come out of the sand with a blackish skin, and possibly they will shrink unexpectedly, this will be governed by the percentage of iron that got into the bronze. However, the castings will not be rendered spongy, in fact they will be densified, and that is the reason they shrink more than clean bronze. The iron has nothing to do with the condition of sponginess, if that is the trouble. We suggest a severe criticism and consequent overhauling of the melting methods. Do not be afraid to use charcoal on the metal and give it plenty of attention as it is melting, to get it as quickly under cover of the charcoal as is possible.

Advises Use of Uniform Cost System

Benefits to Be Derived By Introduction of Such a System Are Shown—Too Much Detail Has Proved Detrimental—Accountant Should Be Familiar With Manufacturing Methods

BY ROBERT E. BELT

AN EXAMINATION of the cost accounting systems of manufacturers within a given industry where no attempt has been made to adopt uniform methods will show that a variety of widely different methods are used to ascertain costs of production. This is particularly true in the matter of determining the cost of producing particular jobs or products. Cost classifications of all conceivable arrangements are found, and no two companies will be treating the same elements of cost in a like manner. Important and appreciably large items of cost will be found to have been overlooked entirely by some companies in determining current product costs. The result is extremely wide differences in costs, which are not true differences but differences, to a large extent, due to variations in methods of ascertaining costs. The result is a condition that is adverse to sound trade relations and to the best interests and welfare of an industry.

Where accounting methods are uniform, costs can be compared and differences can be intelligently discussed and analyzed, inefficient practices can be corrected, waste can be eliminated, costs can be reduced and prices can be made in an intelligent manner. Therefore, the broad benefits to be derived, from an accurate knowledge of costs are twofold—economies in production and intelligence in selling.

The maximum economies in production are very largely the result of an analytical study of comparative costs of production at different plants. With such data the management is enabled to maintain a standard of efficiency for each department of manufacture in keeping with the results of the most efficient. Also no large corporation today attempts to conduct its business with nonuniform methods of accounting, or in other words, without a comparison of costs at the different plants. It is imperative that a comparison be had as only in this way can the relative efficiency of the different plants be determined. If plant inefficiency is disclosed for correction, by means of uniform accounting methods, in a large corporation operating various plants, should not the same benefits accrue to an entire industry by the use of similar methods?

It has been my pleasure to have met with a number of trade organizations during the past ten years where cost information and operating results have been freely exchanged and there is no question in my mind as to the benefits accruing therefrom. Not only are the individual companies aided but the industry as a whole and the public as well are benefited. To my mind, cooperative work of this character, and it cannot be pursued without substantial uniformity in accounting methods, is essential to the economic and financial strength of our industries and to the full development of our domestic and foreign trade.

Exchange Cost Information

In many of our industries certain manufacturers are, and have been for years, interchanging cost data and efficiency methods and the results have been unquestionably beneficial to the participants. If certain manufacturers within an industry can profit from an interchange and study of comparative costs and operating results, would it not be equally advantageous to all manufacturers within an industry? The medium by which this can be done, and the only one of a common language, is uniform accounting.

The advantages of uniform accounting methods throughout an industry to the individual manufacturer and to the industry in general from the standpoint of unfair competition are of equal importance. There is a form of competition to which a manufacturer cannot object, even though it cannot be met, and that is the competition of the man who knows exactly what his goods cost to produce and to sell and whose price reflects advantages by reason of efficient methods of production and distribution. The competition, however, to which objection can be rightfully raised is that of the man, who, having no dependable knowledge of his costs sets prices which preclude the possibility of there being an adequate profit in the business for anyone. It is this situation that a knowledge of costs largely corrects for rarely does a business man price a product at less than cost when he knows its cost, but if he does not know its cost the price may be less than the actual cost. Uniform accounting, which recognizes the fundamental principles applicable to cost finding in the particular industry, has the effect, therefore, of eliminating unfair and unintelligent competition. But uniform accounting in itself does not regulate prices and does not in any measure restrict competition.

The adoption of uniform accounting methods does not mean uniform costs. There is and always will be differences in costs of production. It is natural and right that there should be differences in costs, but such differences as do exist should represent actual conditions resulting from better plant organization, higher efficiency, more favorable location, and other operating factors. In the industries where uniform cost methods are recognized and followed the members know that differences in costs are due to operating factors, as their costs are built up in a like manner and they include like elements of cost. In competition the companies can feel that they are competing on an equal basis and have the satisfaction of knowing that they will not be called upon to meet a price that has been based upon widely different costs determined in an entirely different manner.

Uniform methods of cost accounting if safely and successfully applied in a particular industry must of necessity be strictly adaptable to the technique and operating conditions in the particular industry. That is, if success is to be attained, uniformity must be treated as an industry matter. It cannot be otherwise, as different methods and processes of manufacture call for different methods of accounting. The accounting procedure that is applicable in determining costs in the manufacture of cement, for instance, would not be suitable for ascertaining the costs of manufacturing brick. However, within a given industry it is rarely found that variations in methods or processes of manufacture seriously affect the successful application of fundamental principles of accounting throughout the industry. In the production of

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malleable iron castings, for instance, the accounting principles and procedure are the same whether the castings are light or heavy, whether the air, open-hearth or electric furnace is used as the melting medium, or whether the castings are annealed in the conventional design of oven or in the later and more modern continuous Dressler kiln. As long as the final product is fairly standard and the steps in the manufacture of it are similar, minor variations in manufacturing methods or processes do not in themselves interfere with the successful application of uniform fundamental principles of accounting. Of course, there should be variations in the accounts to take care of different operating conditions but these need not interfere with the observance of standard fundamental principles of accounting.

While the fundamental principles of cost accounting throughout a given industry are essentially the same and reasonably applicable to all plants, nevertheless, in almost every plant there are operating conditions which are peculiar to the particular plant and which have a bearing on cost methods. For this reason, when a concern adopts literally a so-called uniform cost system, it does not always work out satisfactorily.

The accountant should model the cost system, in every case to fit existing operating conditions at the plant rather than attempt to fit conditions to the system, and before any move is made to install a uniform industry system a careful examination of plant practices should be made. With only a little labor in making a physical examination of plant practices and operating conditions the fundamental principles of cost accounting applicable to the industry can be readily and satisfactorily applied.

Visit the Plants

Before attempting to devise an industry system of cost accounting it is best for the accountant to visit, if possible, all the members of the industry, which can be readily done when the number does not exceed forty or fifty. In this way he will become thoroughly familiar with every phase of manufacturing technique and with unusual or exceptional operating conditions. He will observe also a number of factors which have a direct bearing on a unified cost practice. Among these may be mentioned variations in departmental operations, or in departments of manufacture, methods of storing and issuing raw materials, basis of labor payments—whether piece rate or day rate, etc. Liberal notes should be made of the exact practice of the company and copies of all cost records and forms in use should be secured, not only as information of the company's practice, but as indicative of what changes are necessary later to make the practice conform to the uniform one.

In devising a system for an industry, the accountant not only should be thoroughly familiar with the manufacturing technique of the industry, but with sales conditions as well.

Knowledge of the manufacturing technique which is so essential to success in cost work should be broader than that of one or two concerns. It should be a working knowledge of all the essential factors of manufacturing conditions.

Sales Conditions Govern

An understanding of sales conditions is of importance as the cost unit must correspond with the sales unit. For example, in the production of chilled iron car wheels, all standard sizes and weights of which are sold at the same price, the primary objective is a cost of standard wheels and the secondary objective is a cost of each size or weight of wheel. As another illustration, if it is the custom to sell a product such as castings on a flat price basis, or a given price for different classes of product, the cost system should be so designed to give in the first place a cost of the productor products for which a given price is received, and in the second place a cost of the different types of product embraced in the group order. The latter cost, in many ways, may be more important than the former, but nevertheless an exact cost of the product which is comparable in class and quantity with selling value must always be known.

After the accountant is thoroughly posted and conversant with the existing operating conditions and cost practices throughout the industry he is then, and only then, in a position to safely devise a general or uniform practice. Before attempting to outline the fundamentals to observe in formulating a general or uniform cost practice let me add that my experience has been that it is best to be influenced by and to follow practices which have been tried and proved rather than to adopt something untried and with which no company has had an experience. In every industry a number of good, though differing, cost practices will be found, and there is always sufficient good material, even though weak links are found among the strong upon which to build a system every principle of which has proved its usefulness and practicability.

Generally speaking, the only basic principles that need be observed in designing a workable uniform cost practice are a standard classification and definition of cost accounts and a standard method or methods of distributing indirect costs or overhead expense.

The foundation of a common cost practice, and the most essential principle, is a standard classification and definition of accounts. A standard classification of accounts does not mean, and should not mean, exact uniformity either in name or number of the cost accounts. However, it does mean that certain general and well established cost divisions be strictly observed. The divisions are usually termed departments and listed in the order of the sequence of manufacture. Under each primary cost division or department there should be shown and defined only the general accounts which are common to all concerns, such as direct and indirect labor, fuel, supplies and tools, repairs and the fixed charges of the department. These general accounts should be sufficiently inclusive in their definitions to comprise every item of cost incurred in or by the particular department.

Main or general accounts in most cases will be sufficient in number for the smaller manufacturer whose need for detailed information is not so great, while the larger manufacturer can and should subdivide the general departmental accounts to suit his particular needs and requirements. To illustrate, in a foundry there should be a general departmental account which we will style "Molding Department Supplies and Tools." The small foundry likely will prefer to have a single account which will represent the cost of all molding supplies consumed, while the larger foundry most likely will desire an account for molding sand, chaplets, partings, etc. Though the accounts of the small concern and the large concern differ in number, if they both observe the same general cost divisions their results for groups or departments are just as comparable as if both carried accounts identical in number and in name.

Keep Down Number of Accounts

The standard classification of accounts should be accompanied by definitions in which every character of operating expense chargeable to the account is specified. In the preparation of a classification of accounts it is always best to keep the number of accounts down to the minimum. The smaller concern is not so liable

then to become frightened over what to him seems unnecessary detail. The larger company, generally with a more competent accounting organization, is in a better position to expand a standard classification of accounts than is the smaller one to contract it.

The second basic principle of a uniform cost practice, namely, a standard method or methods of distributing costs or overhead expense is as important as the classification and definition of accounts. Wide differences in costs which are due to variations in accounting practice are more often due to the use of different methods of distributing overhead than to anything else. This is particularly true in industries where indirect costs represent a good proportion of the total cost of production and where different bases for overhead expense distribution can be used with seemingly good results.

In formulating a uniform industry practice it is always well to gather the maximum amount of information with respect to the overhead bases in use throughout the industry and the cost variations that arise therefrom. It is a good practice to take the operating costs of a typical company or companies for a month or a quarter and ascertain the variations in costs of different individual products by distributing overhead expense upon different bases, as an example, the weight basis, the direct labor basis, the man-hour basis, the machine-hour basis, or such of them as are found to be in use in the industry. Where the product is not standard but varies in weights, sizes, or designs, the variations in production costs through the use of different methods of distributing overhead will be surprising. For this reason a common practice of distributing overhead expense is most desirable. It is by far the most important phase of uniform accounting. However, a standard classification of accounts must precede a common method of overhead expense distribution or otherwise it would not be possible to aggregate expenses of a given kind or character for purposes of distributing them by a common method.

Standard Forms Desirable

Having considered in a summary way the two fundamental basic principles of a uniform accounting practice it might be well to mention another desirable feature although of considerably less importance. It is convenient when the forms of cost records and statements are uniform or substantially so, but this is not an essential and no effort should be made toward this end until the two basic principles are well established and in general use. But there is no good reason why a standard form of monthly cost statement should not be adopted. There naturally should be the same degree of uniformity in the monthly cost statement, both in form and arrangement, as is in the classification of accounts. It is always well to show as a part of the uniform accounting procedure a standard form of monthly cost statement and suggested forms of other principal cost records.

Assist Cost Accountants

The introduction or the general use of uniform methods is the goal. The success of the effort usually depends upon two things, namely the practicability of the plan and the methods adopted to introduce it. We are here dealing with methods of introduction, assuming that the plan is a practicable one.

In the first place, it is good policy to secure the co-operation and advice of the accountants of the members of the industry during the latter stage of the preparation of the uniform system. After the person who has devised the system, and is responsible for it, has covered the necessary field work and has formulated a plan which to his mind is the best and most practicable, great assistance is secured by inviting the accountants, whose co-operation is so essential, to take part in a meeting where both the prevailing conditions and the principles which are thought to be the best for adoption throughout the industry are thoroughly explained. In addition to the assistance secured in this way, there is the equal importance of the feeling among the cost accountants that they have been consulted and have had a part in the formulation of the uniform practice.

The system having been approved, the next step is to give the several cost accountants such assistance as they need in the work of making the necessary changes in their cost practice to conform to the standard approved practice. The amount of work involved will depend upon the changes to be made but ordinarily a couple of days work on the part of the supervising accountant will be all that is needed.

The work of convincing executives who are not in accord with the movement and who believe their system is better than the standard one, even though it is an infamy to call it such, forms no small part of the efforts of the supervising accountant. While this phase of the work is the unpleasant and trying part, it is highly important and if progress is to be made must be handled with tact and diplomacy.

Unquestionably a great deal of progress has been made during the past few years in improving cost methods and in bringing about a greater degree of uniformity. However, not all of the efforts have been successful. In fact, it is the belief that as many attempts to bring about standardization have proved unsuccessful as have proven successful. The responsibility, I think, is about equally divided between the failure of business interests to co-operate and the inherent weakness of so-called uniform systems.

There is a certain amount of non-co-operation in every industry, which retards progress even though the accounting procedure is the best and of the practical type that meets with most universal success. If the structure is a sound one usually the necessary co-operation can be won. It is difficult to secure co-operation, and rightly too, when the plan is not a good one and above all not an entirely practical one.

While a cost system should be fully adequate to the needs of a business it should not be top heavy. All unnecessary detail or red tape that does not justify itself with practical results should be eliminated. A common shortcoming of uniform systems is the exacting refinements.

The reasons for the failure of most cost systems, whether designed for a single manufacturer or a group of manufacturers in the particular industry, is their impracticability. They are too complicated; too complex; too much emphasis is given to unimportant matters and too little to important considerations. The mistakes are generally due to a failure to grasp the accounting or the manufacturing essentials involved.

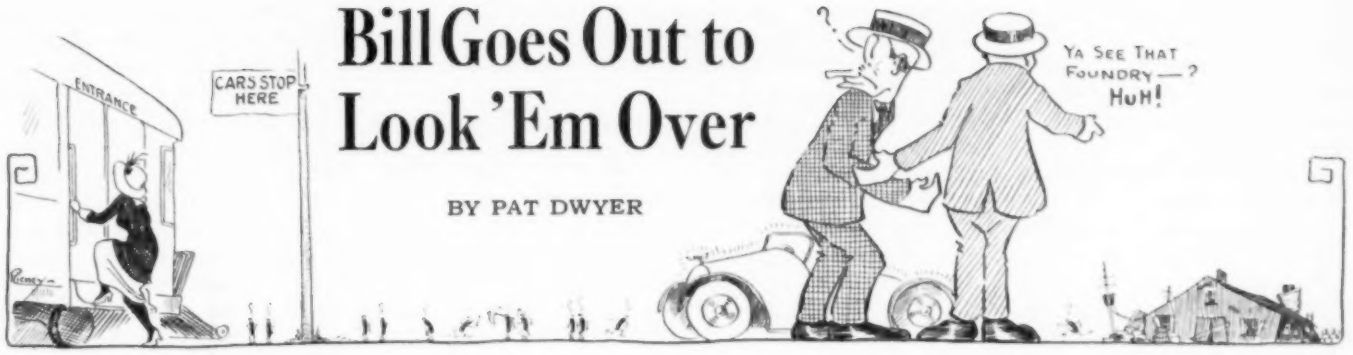
Acquire Furnace Rights

F. J. Ryan & Co., Franklin Trust building, Philadelphia have taken over the exclusive rights in North, South and Central America for the electric furnace developed by the Bario Metals Corp., under patents issued to Paul de Miles. The furnace equipment has been melting commercially special acid resisting alloys and rare metals especially platinum and palladium. It is designed to melt metals having a melting point as high as 3450 degrees.

The Pittsburgh Electric Furnace Corp., Pittsburgh, has established offices at 149 Broadway, New York City in charge of Presley Hamilton.

Bill Goes Out to Look 'Em Over

BY PAT DWYER



HAVING heard or seen nothing of Bill for some time I called at his house one night recently and found that he just had returned from a week's trip out of town. His journey had been undertaken partly for pleasure and partly for business. I am not one whose nose has been worn down to a sharp point from continually poking it into other people's business, but at the same time I never have turned the cold shoulder or the frozen stare, as the saying goes, on any man who evinced a desire to unburden his mind to me. This sentiment also applies to women who, contrary to the belief I cherished for many years, have just as many troubles as men and are just as willing to tell them to any person they consider disinterested and neutral. I should be deeply grieved if any person should infer from the foregoing that I have found the ladies reticent in expressing their opinions. Not at all, not a-tall. What I wish to convey is that they do not always say what they mean. Talking, and saying something are two altogether different things.

However, what I started to say was that, while I would not for the world come out flat-footed and ask Bill where he had been, who and what he had seen and how much had the trip set him back financially, and other vulgar questions of a like character, I would not voluntarily throw any obstacles in his way if he insisted on telling me *all* these things. For that matter, why should I stop any man who wished to confide in me? It seems to do them good and does me no harm. On the contrary occasionally, I find a grain or two of wheat in the bundle of chaff which forms the bulk of the conversation indulged in even by our best people during these parlous and degenerate times.

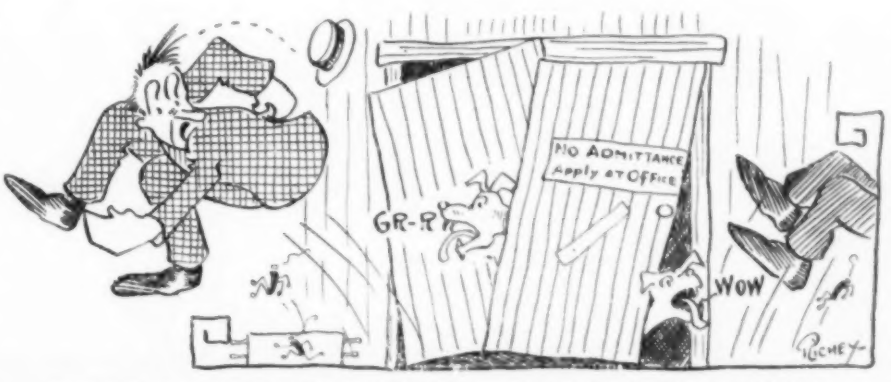
On this occasion I merely asked Bill how he had made out on the trip, fully expecting him to say, "Oh just so-so" as he had said on many former occasions. We both have covered considerable territory in our time and stand ready and willing at any and all times, with or without provocation, to corroborate the statement credited to the late lamented King Solomon, "there is nothing new under the sun."

This time I was disappointed, agreeably disappointed, if such a thing is possible, for Bill unfolded a tale that would have taxed the credulity of at least two strong men, and one that even I would have found great difficulty in believing had it come from any other person. Whatever doubts I may have had during the early part of the narrative were set at rest when he produced a photograph taken by a perfectly reputable firm of photographers, duly stamped with the firm's name and dated on one of the days which I knew Bill had spent in that city.

It may be claimed by some of those suspicious people who never believe anything, that Bill, instead of spending the week in a famous city as he claims, spent it in one of those moonshine centers which, it would appear, still flourish in this fair land. Others, again might be tempted to say that he had spent the week in the company of a band of movie heroes and had brought back a picture of the location used in one of their thrilling six-reelers. However, knowing Bill as I do, having examined the picture and having heard his story I am willing to believe at least 50 per cent of it and now if you will only believe the other 50 per cent, we can consider that the thing has received our approval to the extent of the regular 100 per cent. In other words let us make it unanimous.

"I am here to tell the world," said Bill, "that I saw two foundries up in that town the like of which I never had seen before. One probably is the finest of its kind in this country. They make 100-ton castings in this one as a matter of daily routine and think nothing of it; but the other,—well the other is like nothing that is in the heavens above, the earth beneath or the waters under the earth. It is the only one of its kind in existence and if the late lamented P. T. Barnum was alive, I see where he would have made a tidy pile in exhibiting the curiosity to a select list of these athletic gentlemen who toil and moil in the dust and grime of the foundry.

"It is entirely within the bounds of probability that others beside foundrymen might have been interested, but only those connected directly with the casting industry could appreciate the masterpiece at its full value. It represents all that is left of a one time million dollar corporation. It may be compared to a raft made up of chicken coops and other odds and ends hastily launched after the captain has been washed overboard, the ship piled up on a sunken reef. It embodied all the other accessories employed by those gifted scenario writers who never saw salt water, but who depict so skillfully incidents from the lives of those who go down to the sea in ships." "During my stay in the town" said Bill "I met a bunch of regular guys who made the dark places light and the



THE THRILL THAT COMES ONCE IN A LIFETIME, ONCE IS ENOUGH

rough ways plain for my unwary feet."

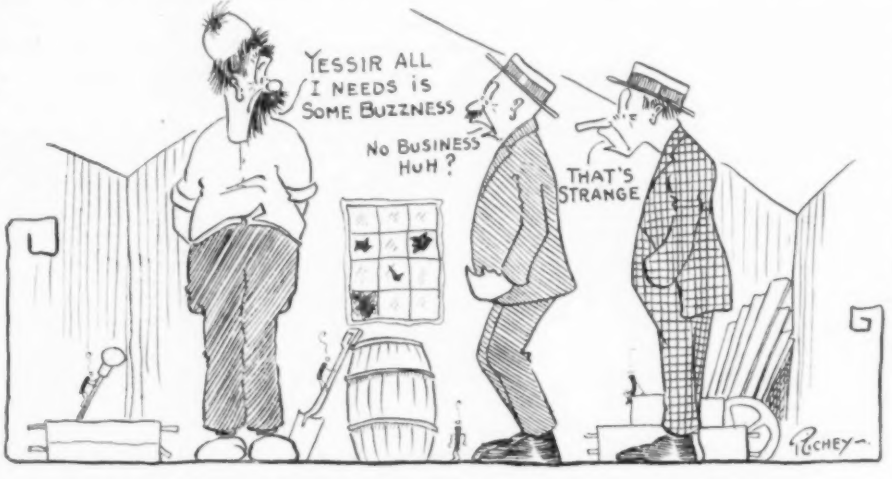
"Due probably to his foundry training he drops at times and in the most startling manner into the vernacular. However, since the majority of the readers of these veracious chronicles slip occasionally in the same manner, I feel reasonably certain that they will view these slight lapses with kindly toleration. If there be among us some purists who think that I should suppress or sterilize some of Bill's free and easy expressions, I have only to say that I was brought up in a hard school where I was taught to hew to the line let the chips fall where they will and all that kind of stuff, and if Bill occasionally calls a spade a spade it is not for me to have him call it an agricultural implement. Let us continue. Having informed me that the gentlemen whom he had the pleasure of meeting were a bunch of regular guys he elaborated. "One of them I have known for many years and he treated me like a,—I was going to say prodigal son, but instead let us say a long lost brother and the others whom I only had known heretofore by reputation fully lived up to all I had heard about them. You may say what you like about the bond between the members of a fraternal organization, but there is an intangible bond between those who have shoveled and pounded sand in iron, steel and brass shops, made cores, daubed the cupola, charged her and tapped her out; between those who have spent years in the foundry and worked their way up to the position of master craftsmen, that is stronger than the bonds of any fraternal organization."

If there is one thing in the world more than another that makes the average citizen feel peevish it is when some person tells him something which he already knows in its entirety. A familiar example of what I mean, is when the lady of the house who could not hit a nail twice with a hammer if it were to save her immortal soul from perdition, elects to tell you how to hang a picture or how to nail a row of tacks along the edge of a screen. I am no exception to the rule and, therefore, I told Bill he was wasting his time. A fair to goodly quantity of water had flowed over the old mill wheel since I had gone through my first initiation and he could not tell me anything about fraternal organizations. I told him if he wished to say a word or two about the picture I willingly would listen, but I did not want to hear any sermons. I long ago had reached the saturation point.

"Saturation point is good," said Bill. "If you had paid any attention to the sermons instead of letting them in one ear and out through your elbow on the few occasions you were not fast asleep, you might talk about saturation point. As it is you should be down on your knees petitioning for wit to appreciate my occasional words of wisdom. There is a proverb which you may have heard, although I doubt it, about throwing pearls around promiscously.

"Practically every foundryman I met asked me if I had seen the Southern Queen Stove & Range Works and they assured me individually and collectively that if I went away from the city without paying the plant a visit I might set my journey down as wasted effort and all I had seen and heard as the modern equivalent of a sounding brass and a tinkling cymbal. "One of the estimable gentlemen placed his machine at my disposal and personally drove me out to see what he claimed to be the most unique specimen of foundry architecture in these United States. In fact he doubted if it could be matched in any country on earth. On the way he related the history of the place which proved to be another illustration of the age old fact that eternal vigilance and intelligent supervision are necessary to success and that a business that is left to run itself eventually will run out of existence.

"The founder of the company was a practical foundryman who had built up an enviable business, employing approximately 100 molders. So long as he had given the business his per-



WHAT HE REALLY SEEMED TO NEED WAS A HAIR CUT AND SHAVE

TALKING ABOUT SHIPS AND SHIPWRECKS, WHAT HAS BECOME OF ALL THE OLD SCHOONERS?

sonal attention it had flourished like the proverbial green bay tree, but age and infirmity finally forced him to relinquish the management in favor of a relative by marriage who, while a perfectly estimable citizen knew as much about the foundry business as little Dan Cupid knows about shooting snipes.

"The business ran along on its own momentum for a short time, but gradually began to slip and finally the foundry building burned down. Instead of gracefully giving up the ghost and admitting that he was beaten, the manager with that species of mistaken zeal which characterizes those who refuse to recognize that the successful prosecution of the foundry business requires highly trained and expert supervision, decided to start again on a small scale. With this object in view he secured a tract of land on the outskirts of the city and moved everything spared by the fire.

"I learned many other interesting facts on the journey, but when finally we came in sight of the *foundry*,—the saints be between us and all harm,—I realized that like Sheba's famous queen, the half had not been told me. Situated in a hollow close to the main road and in proximity to a small stream, a miscellaneous mountain of old flasks and follow boards sufficient for a shop running 100 molders, almost concealed the foundry from view. At the entrance to an alleyway between piles of flasks a rusty and weather beaten sign warned the casual wayfarer that there was no admittance, apply at the office.

"I ask you now as between man and man what's a sign among friends? Why, nothing at all. We continued down the alley at the imminent risk of being buried under an avalanche of falling flasks, until we approached the exterior of the building. It was encircled by a moat about two feet deep which we learned later was designed to prevent the surface water from the hill from flowing through the many openings in the wall and flooding the floor. A couple of planks, laid across the moat at one point, furnished an entrance to the doorway of the building.

"The door was closed and held in place by a long piece of 2 x 4 scantling. Under ordinary circumstances, we should have taken that as an indication that the place was closed to visitors and others, but having come so far we decided that we deserved one peep inside. All was quiet with apparently not a living soul in the vicinity, but the minute we opened the door a ferocious yellow dog, his lady friend and a young member of the family, presumably the heir apparent, came bounding forward with the evident intention of eating us there and then, body and bones, without salt or without benefit of clergy.

"Believe me, that door was slammed shut and the scantling replaced in jig time and if Marmion flew out of the castle of old Jerry Douglas any faster than we hopped that moat and pulled the planks across after us, he must have traveled. Neither of us was scared, you understand, but upon comparing notes it transpired that we both were constitutionally opposed to the idea of letting strange dogs bite us. It simply is not done, you know.

"Essentially I am a man of peace and was for beating it while the beating was good, but Henry,—did I tell you that his name was Henry?—said no. He declared that no dog or for that matter, no family of dogs was going to jump at him and get away with it. He proposed that we enter the charging floor from a horizontal runway leading from the side of the hill. Then, he said when the dog family ran in below we could drop a couple of hunks of pig iron on them, a measure which he felt reasonably certain would knock all the bark out of them.

"I must confess that the merits of the plan appealed to me and we were only prevented from carrying it out by meeting a man on the way who told us that he was the proprietor and also asked us courteously what our business was. Henry told him he was state factory inspector and would like to look over the plant to see if it complied with the various requirements of the Factories Act.

The owner, who bore a striking resemblance to John the Baptist as he is depicted in ancient prints and before Salome had him served up *a la carte*, seemed delighted at the suggestion and only regretted that he had no men working at the time to give a practical demonstration of the general efficiency of the plant. He was well equipped and ready to go into operation at any time, the only two obstacles being a lack of orders and an apparent scarcity of molders. He had done a little overflow work for some of the foundries in the vicinity during the period of activity following the signing of the armistice, but recently, he admitted he had been shut down. He was quite sanguine of the future and claimed that with his low overhead he could afford to underbid any foundry in the city.

"His taxes were low, since they were based on the valuation of the plant and since no insurance company would accept the risk, he was relieved of all insurance premiums. His water cost him nothing. All his men had to do was to step out the back door and dip it up out of the stream. He pointed with pride to the horizontal runway connecting the stock yard with the charging platform. It not only relieved him of the necessity of an elevator, but, as he saw it, the safety factor was unusually high. He explained the purpose of the moat around the building and then asked us to kindly step inside and look over the molding and melting facilities.

"A little 24-inch cupola was set up in a space, partitioned off from the remainder of the foundry. This space also served for a cleaning room. Our guide started the motor to demonstrate the clutch arrangement which allowed him to run the fan or the tumbling barrel either singly or together and 'pon my word I was afraid the building would come down on top of us before we persuaded him to shut her off. The molding floor remained in the condition it had been left after the last cast. Flasks and bottom boards were thrown indiscriminately up against the wall on all four sides and such a holy mess I am sure never has been seen since a band of wise old birds uncovered the ruins of Pompeii and Herculaneum.

"The walls of the building were made of window sashes, pieces of plank, bottom boards, tar paper and strips of sheet iron. I had a photograph taken for the benefit of my oldest girl. She is graduating from high school this year and has chosen for a theme "Ship Wrecks in Business."

"With all due respect to the young lady" I said "and in fact with all due respect to young ladies in general, what in the name of Minerva, goddess of wisdom, does she or any other young lady know about business shipwrecks?"

"Not a thing," said he, "but I kind of figure that photograph will supply all the necessary inspiration."

Purchasing Agents Make Sight Seeing Trip

Members of the Pittsburgh Purchasing Agents association on June 21 made a sight seeing trip to Youngstown. They were guests at the plant of the General Fire Proofing Co., and also the Republic Rubber Corp. At the dinner held that evening they were addressed by James A. Campbell, president Youngstown Sheet & Tube Co.; A. E. Adams, president Dollar Savings & Trust Co.; and Charles Leedy, Youngstown.

Oil Lowers Cost of Fuel in Cupola

Austrian Foundryman Introduces Oil Firing as an Adjunct to Coke in the Cupola and Decreases Cost of Fuel Besides Securing Metal With Materially Lower Sulphur Content

BY KARL K. BERTHOLD

THE complete breaking down of the supply of fuel in Austria lately, resulted in an unusual shortage in the allotment of melting coke and the fantastically high increasing prices for illicit coke in the past months created a demand for a substitute for coke in the operation of the cupola. This demand was supplied by some other fuel in an always increasing proportionate value. Gas coke proved to be too brittle and too sulphurous, also the use of charcoal was useless on account of its slight resistance to pressure.

Owing to the great success which has been obtained with oil firing in other melting processes, in economical as well as in metallurgical respects, it was obvious that it was advisable to risk the experiment of oil firing the cupola. In order quickly to come to practical results it was important to perfect an oil burner for use with the cupola, which, without costly and troublesome alterations, or interruption of the operation could be installed in a normal furnace.

After careful testing of the operation requirements two burners were put in an ordinary and otherwise unaltered cupola with suitably constructed air inlets and standard contrivances built in. The results from the first day to the conclusion of the preliminary tests, shown in the accompanying table indicate how success has been evolved from these groping experiments.

The cupola used for the experiments was lined to 800 millimeters (about 32 inches) in diameter and had four tuyeres. The blast pressure was 350 to 400 millimeters (13.8 to 15.8 inches) water column. At first two burners were employed but it was found that when oil was supplied above a certain rate the flame smoked, indicating incomplete combustion. As the volume of air delivered through the tuyeres was calculated to be sufficient it was decided that the trouble was due to too concentrated a flame and the number of burners was increased to three, this eliminated the trouble due to incomplete combustion. With three burners the amount of coke necessary was markedly lowered and the melting rate was increased as shown in the table.

Another advantage not to be underrated is the extremely favorable action of the oil-firing upon the chemical composition of the iron. Accurate analyses that were carried through from the beginning of these experiments show that the absorption of sulphur, so very much feared from the poor quality of coke used, was materially lessened by the adoption of oil-firing. Due to this partial elimination of the sulphur the principal cause of hard castings was removed. With normal coke firing the iron contains about 0.14 per cent sulphur; with oil-firing the amount of sulphur can be reduced to about 0.07 per cent. This reduction of sulphur is accomplished because the oil is low in sulphur and considerably less coke is used.

Again with oil-firing the temperature of the iron being melted can be regulated in the shortest space of time. For any special purpose or for thin-walled castings one may obtain a ladle of very hot iron by increasing the oil pressure at the burner, whereas in coke firing one has to wait until the additions to the amount of coke through the charging doors reaches the melting zone before increased heat is secured. The increase of the hourly melting production also is an important advantage. A benefit which has not been definitely measured is the reduction in the amount of slag because of lessened coke used, and hence a saving in the corrosive wear of the lining.

The operation of the cupola with additional oil-firing as compared with

Table I

Data on Melting Iron with Coke and Oil

Number of burners	Total working charge—Wt. of unit charge 880 lbs.	Coke on bed, lbs.	Coke between charges, lbs	Lbs. coke used per 100 lbs. molten iron	Lbs. coke between charges per 100 lbs. iron	Total oil used, lbs.	Oil per 100 lbs. iron	Melted per hour, lbs.	Remarks
2	18,480	1122	1210	12.6	6.6	178	0.96	8932	Temperature too dull for thin-walled castings.
2	14,520	1188	1181	16.3	8.1	...	....	7018	Temperature same as without oil.
2	12,760	1254	704	15.3	5.5	134	1.05	9218	Temperature same as 1.
2	22,880	1276	1716	12.9	7.5	62	0.27	7612	Temperature dull. Oil-firing discontinued earlier.
2	19,360	1188	1331	13.0	6.8	139	0.71	7612	Temperature at beginning good, then dull. Good at the close.
2	20,680	1188	1177	11.4	5.69	156	0.75	7524	Temperature same as 1.
2	21,120	1188	1188	11.2	5.62	150	0.70	7766	Temperature same as 1.
2	21,120	1188	2002	15.1	9.5	...	....	6842	Temperature good, without oil.
3	23,320	1188	1199	10.2	5.14	128	0.55	7876	Temperature very good.
3	19,800	1188	924	10.7	4.7	110	0.52	7766	Temperature good.
3	28,600	1188	792	10.46	4.19	251	1.32	7502	Temperature very good.
3	26,400	1100	1034	8.08	3.91	321	1.21	7920	Temperature very good.
3	24,640	1100	1232	9.47	5.00	295	1.20	9482	Temperature very good.
3	29,040	1188	1430	9.02	4.9	266	0.92	9482	Temperature very good.
3	18,480	1100	946	11.1	5.1	161	0.93	8998	Temperature very good.
3	18,920	1100	792	10.0	4.2	173	1.44	8734	Temperature very good.
3	27,390	1100	1122	8.11	4.1	238	0.86	8866	Temperature very good.
3	30,800	1188	1100	7.85	4.0	229	0.74	9724	Temperature very good.
3	28,820	1188	924	7.32	3.26	218	0.75	9350	Temperature very good.

From Stahl U. Eisen, March 24, 1921. Translated specially for THE FOUNDRY by R. W. K.

CHEMICAL ANALYSIS OF PLAIN CARBON STEEL

(Continued from Data Sheet No. 386)

Barium-Hydroxide Solution—A saturated solution is filtered and stored in a large reservoir from which it is delivered by air pressure, protecting from carbon dioxide by a soda-lime tube. Three or four small bulbs of the Meyer tube are filled, and CO_2-free water is added until the remaining small bulbs are filled.

Factors Influencing Rapid Combustion

Size of Particles of Sample—The finer the chips the better except with samples which burn too vigorously (see under "Rate of Admitting Oxygen"). Particles too coarse to pass a 20-mesh sieve are not recommended, nor long curly drillings which will not pack closely. A ½-inch flat drill may be used for taking the sample and the pressure and speed of the drill-press regulated to secure the desired result; or, better still, the sample may be obtained with a small milling machine suitable for sampling, or by a shaping machine. Oil, dust, and other foreign matter should be carefully excluded.

Manner of Distributing Sample in Boat—This is of considerable importance. With all samples, close packing in a small space is conducive to rapid combustion. In the case of samples which burn too vigorously, a satisfactory regulation may sometimes be attained by spreading the sample loosely over the lining in the boat.

Rate of Admitting Oxygen—The rate at which oxygen is admitted is also a factor in the velocity of combustion. Assuming the combustion apparatus to be heated to the temperature range recommended (950 to 1100 degrees Cent.), it is possible, if the material is closely packed and if oxygen is admitted at too rapid a rate, that the combustion may be so violent as to cause excessive spattering of fused oxides, and such fluidity of the molten slag that the boat or other container may be injured or destroyed; therefore a moderate rate of burning is to be sought. This is desirable also from the standpoint of the complete absorption of the carbon dioxide by the barium-hydroxide solution. The factors, temperature of combustion apparatus, manner of distribution of sample, and rate of admission of oxygen, can be governed so as to burn successfully steels of a very wide range of compositions, in either fine or coarse particles.

Method

After having properly set up and tested the apparatus, place 2 grams of steel (see Note No. 1) in the form recommended, in a moderately packed condition on the bed material and introduce the boat into the combustion apparatus, already heated to the proper temperature. After about a minute (to allow the sample and container to reach the temperature of the furnace), admit oxygen somewhat more rapidly than it is consumed, as shown by the rate of bubbling in the Meyer tube (see Note No. 2). The sample burns completely in 1 or 2 minutes, and all that is now necessary is to sweep all the carbon dioxide into the absorption apparatus. This can be accomplished in 6 to 8 minutes by passing about 1 or 2 liters of oxygen. Detach the Meyer tube (see Note No. 2) and filter and wash the barium carbonate, using the special filtering apparatus shown. After solution in a measured excess of hydrochloric acid (the Meyer tube being washed out with a portion of the acid, to remove adhering barium carbonate), titrate the excess of acid against alkali and from the data thus obtained calculate the percentage of carbon.

(Continued on Data Sheet No. 388)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

CHEMICAL ANALYSIS OF PLAIN CARBON STEEL

(Continued from Data Sheet No. 387)

Notes

1—When working with steels high in carbon (above 1 per cent) it is advisable not to use more than 1 gram for example in order that filtration may be sufficiently rapid.

2—As a precaution against error resulting from too rapid passage of the gases, it is well to attach a second barium-hydroxide tube to retain any carbon dioxide that may pass the first.

3—For the most accurate work the Meyer tubes should be washed with dilute acid before beginning work each day. After a determination is finished the tube should be completely filled two

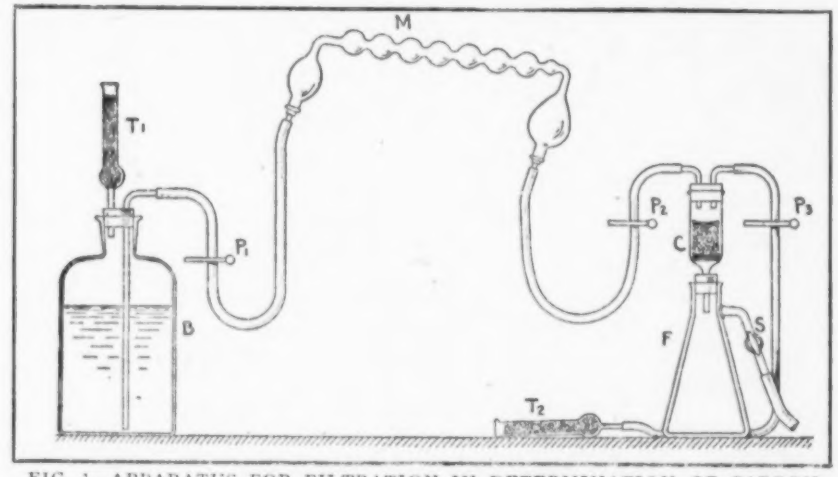


FIG. 1—APPARATUS FOR FILTRATION IN DETERMINATION OF CARBON BY THE DIRECT COMBUSTION METHOD

or three times with tap water, then rinsed with distilled water, in order to remove the carbon dioxide liberated when dissolving the carbonate from the previous determination.

4—The flask containing the carbonate should be thoroughly agitated after adding the acid, since the carbonate sometimes dissolves rather slowly if this is not done; this is particularly the case if it has packed much during filtration.

(Continued on Data Sheet No. 389)

THE FOUNDRY DATA SHEET, JULY 1, 1921
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

normal coke firing is scarcely altered. The charging follows that of straight coke firing in every way with the exception that less coke is put between the charges. The working control in oil-firing can be mastered in a short time by any intelligent furnace operator. The burner is installed at the beginning of the operation. Whenever a special casting has to be made requiring hotter or duller iron it becomes a simple matter to regulate the burner as the case may require. The inclination to bridge formation is greatly reduced with the oil-fired cupola. Should bridges ever form they can be removed readily by increasing the amount of oil delivered to the cupola, with additional air pressure.

The economical advantage of the oil firing is illustrated by the following example. In the months past it was possible in some degree for all busy foundries to have assigned them a certain quantity of coke to be gotten from the points of government distribution. The necessity of smuggling coke was admitted. It was assumed that about 35 per cent of the coke required was obtained by illicit means.

The price per kilogram (2.2 pounds) for coke in October 1920 was 5.50 kronen, 11 kronen for illicit coke and 30 kronen assigned for oil. The heats, the one in which coke entirely was used for melting and the other in which both oil and coke were used show the saving secured by the use of oil.

Coke Operation

Coke on bed	350 Kg.
Coke between charges, 11 Kg. per 100 Kg. of iron	1650 Kg.
	2000 Kg.
Total 1300 Kg. coke at 5.5 Kr.	7150 Kr.
Total 700 Kg. coke at 11 Kr.	7700 Kr.
	14850 Kr.

Oil Operation

Coke on bed	400 Kg.
Coke between charges, 5 Kg. per 100 Kg. of iron	750 Kg.
	1150 Kg.
Oil consumed 0.8 Kg. per 100 Kg. of iron	120 Kg.
Total—1150 Kg. coke at 5.5 Kr.	6325 Kr.
Total— 120 Kg. oil at 30 Kr.	3600 Kr.
	9925 Kr.

The power expenditure for the atomized air amounted to 2 or 3 horsepower but is not figured in the cost table. The economy with added oil-firing amounts accordingly to 14850 minus 9925 kronen, which is equal to 4925 kronen per casting day ($7.88 at exchange rate of May 5, 1921), a result that the working of the oil-firing plant guarantees in the shortest period of time.

The operation of oil-firing succeeded in reducing coke between charges 4 to 5 pounds with an oil consumption of 0.15 gallons per 100 pounds of iron melted. The hourly melting production was increased 30 to 40 per cent and the temperature of the iron was suitable for pouring thin-sectioned castings, while the amount of sulphur taken up from the coke was materially lessened. While these experiments were carried out under conditions difficult to parallel under ordinary circumstances, still they seem to indicate that oil can be used to advantage.

British Iron Research Association Meets

BY JOSEPH HORTON

(British Representative of THE FOUNDRY)

GREAT progress has been made in the development of the British Cast Iron Research association, a comprehensive organization in which the promoters frankly acknowledge their indebtedness to the American Malleable Castings association, and whose example they are seeking to follow as closely as possible. The headquarters now are located at Central House, New street, Birmingham. The necessary preliminary formalities have now been completed, Lord Weir, G. & J. Weir, Ltd., Holm Foundry, Glasgow, has been made president, and a strong body of officers has been elected.

On Tuesday, May 24th a meeting specially convened to represent all branches of the ironfounding industry was held in the Chamber of Commerce, Birmingham, and about 100 assembled, from all parts of the United Kingdom. In the unavoidable absence of Lord Weir, the chair was occupied by Sir James McKechnie, director, Vickers Ltd., Barrow-in-Furness, and on the platform were engineers Vice-Admiral Sir George Goodwin, K. C. B., L. L. D., president, Institute of Metals, London; Prof. C. H. Desch, metallurgical department, University, Sheffield; Prof. Thos. Turner, head of the metallurgical department, Birmingham University; M. Deacon, M. I. C. E., Sheepbridge Coal & Iron Co., Derbyshire; and J. E. Fletcher, M. I. M. E., St. James Road, Dudley, ex-president, Staffordshire Iron & Steel Institute.

The chairman recalled that in 1916 the government established a department of scientific and industrial research with the idea of bringing scientific knowledge into more intimate relationship with British industries. Germany and America devote a large amount of attention to such matters, much larger in fact than has Great Britain. The speaker summarized the steps taken by the Institute of British Foundrymen in the promotion of the association which culminated at a representative meeting held in Birmingham on Sept. 30, 1920. A provisional council was apopinted which formed the British Cast Iron Research association.

The association work will include the investigation of problems in the manufacture of pig iron, grey iron and malleable iron castings, semicastings, semisteel castings, chilled rolls, cast hollowware and pipe, heavy and light castings, and generally all branches of the cast-iron industry.

Professor Turner emphasized the great national practical importance of the association's work and showed how large a field of study had to be covered. Dealing with the wide field of service, the speaker pointed out that there are as many varieties of cast iron as of steel. Some want fluid cast iron to give a sharp impression in the mold, others want cast iron sound and dense to prevent percolation of water under pressure; some irons must be hard, others of high tensile strength, while another variety must be specially suited to resist oxidation. He stated that this shows the wide scope for the researcher and the experimenter as well as for the collector of information for the general benefit of the trade.

The speaker referred in some detail to American experience. He said:

"A striking example of the value of research is to be seen in connection with American practice. I am sorry our American friend, John A. Penton, who spoke to you a week ago is not able to be here, because he could speak with so much more authority; having been president of the research committee he could speak with personal knowledge.

"The story of the American cast-iron industry is practically a romance. If you go back to the time when the Mason college subsequently the University of Birmingham was established, the black heart industry had not commenced and the white heart malleable was conducted on a small scale. The Americans applied the researches of Forquignon much more keenly."

America makes ten times the number of malleable castings made in Great Britain and Americans have justified their claim that the product is now better and more uniform than ever.

This has been done as the result of a combination of manufacturers working in hearty co-operation. When the American Malleable Castings association began its operations, they were threatened by the introduction of steel to replace malleable because iron was not sufficiently trustworthy. By the adoption of certain definite specifications, ascertaining how they could be complied with, and then insisting on compliance they have largely increased the production of malleable cast iron, and in that way a most valuable material has been furnished for construction purposes. They have not only advanced the scientific side of the industry, but have made considerable profit. The general effect of the American operations has been to raise the standard, generally, and to bring up the poor material to the highest specifications.

Maurice Deacon, M. I. C. E., managing director, Sheepbridge Coal & Iron Co. Ltd., Chesterfield, said he had a feeling that the foundry trade has been too backward in the matter of scientific research, probably the most backward of the iron and steel trades and in view of foreign competition they must put forth their best efforts far surpassing anything done in the past. The advantages they have to offer include fully equipped laboratories, to which members will be permitted on certain terms to send their specimens for analysis. In addition there will be a technical committee, dealing in a somewhat similar way with difficulties and problems arising in connection with their daily work.

He said he attaches the greatest importance to the literature emanating from foreign countries, which is to receive special attention. Everyone has met with the difficulty of becoming acquainted with foreign literature. One of the projects of the association will be the translation of foreign literature by a subcommittee, with the object of placing that literature at the disposal of their members.

Prof. C. H. Desch dealt in some detail with the subjects calling for investigation connected with composition, treatment, conditions of manufacture, improvement of plant, control of castings conditions, etc. The skilled foundryman possesses a large amount of technical knowledge which is not in the text-books and there is a field of useful work to be covered in the coordination of all that scattered knowledge, possessed by the practical man, with a view to its being available for the requirements of industry. One important feature will be the establishment of a central bureau for the collection and interchange of information. An important sphere of service will be the collection of material so that it may be immediately available when it is wanted.

It is hoped to utilize largely existing staffs connected with laboratories and universities. There must be the fullest co-operation between research workers and practical men so that the general knowledge may be made available for practical use. It should be possible to raise enormously the standard of practice in cast iron.

The remarkable contrast was drawn between the finely equipped engineering shop and the often badly lighted and poorly furnished foundry. The foundry often lacks lights, comfort and equipment. While there are exeptions, generally the necessity of foundry improvement has not been realized in the same way as in other departments of engineering. Prof. Desch believes that the association will do much in raising the standard to comfortable working and economical production in the foundry.

In conclusion, the speaker pointed out the necessity for better training of foundry workmen and appeal to all connected with the foundry industry to place their information on the table, and combine for the general benefit. He hoped it might be possible to obtain the co-operation of trade union leaders not simply as individuals, but as organized bodies, for carrying on research work.

Engineer Vice-Admiral Sir George Goodwin, K. C. B., London, said that the association started better than any other association he had known, and, if that program is conscientiously carried out it will do well. He suggested, however, that they had not sufficiently provided for the opinion of the users, who after all must be satisfied, and often are able to give the advantage of valuable and interesting experience.

Book Review

Pattern Making, by Edward M. McCracken, head of wood working department, Johnson School, Scranton, Pa., and Charles H. Sampson, B. S., Head of Technical Department, Huntington School, Boston; Cloth 8 x 11 inches; published by D. Van Nostrand Co., 8 Warren street, New York and furnished by THE FOUNDRY for $2 net.

The authors announce that this book has been written to fill the need for a text the use of which will give to students a sufficient knowledge of the principles of patternmaking as will enable them to make a pattern of any usual type. An effort has been made throughout to select such patterns for description as would illustrate some definite principle either in design or construction. The patterns selected are difficult enough to arouse the interest and industry of the student, but yet not so difficult that they frustrate their object by presenting problems and practice beyond the capability of the ordinary student.

Chapters are included describing the use of tools, both hand and power driven usually found in pattern shops; information concerning woods of various kinds and the principles of molding. The book is especially recommended for use in techinal, trade and vocational schools where the desire is to present a practical course in patternmaking.

Consolidate Supply Houses

The John Hill Foundry Supply Co. and the Hill & Griffith Co., Cincinnati, will be consolidated July 1 under the firm name of the Hill & Griffith Co. John Hill, one of the founders of the Hill & Griffith Co. and one of its officers for many years, will be president and general manager and William Oberhelman will be vice president and manager of the Southern district with headquarters at Birmingham. John Hill is one of the pioneer manufacturers of foundry supplies and his wide acquaintance among foundrymen throughout the United States and Canada dates back to his many years of experience as a salesman. William Oberhelman has been connected with the Hill & Griffith Co. for 21 years. Bruce Hill, who will be sales manager, has represented the Hill & Griffith Co. and the John Hill Foundry Supply Co. in sales capacity in Ohio, Indiana, Illinois, Kentucky, Pennsylvania and West Virginia. The other officers include L. J. Pfeiffer, treasurer, and D. N. Hill, secretary. D. N. Hill represented the John Hill Foundry Supply Co. in the south for the past eight years and formerly was affiliated with the Hill & Griffith Co. Elmer R. Ritter, president and works manager and Percy L. Ritter, general manager of the Hill & Griffith Co. have disposed of their interests and have retired from the business.

By the consolidation of these two companies many economies will be effected and the trade will be served to better advantage than heretofore. A complete line of foundry facings partings, core compounds for iron, steel and brass foundries will continue to be manufactured as well as supplies and equipment for general use in casting plants.

The business of Ford & Kimball, Concord, N. H., brass founders, has been reorganized with Ralph A. Benjamin as manager and Nathaniel G. Shaw as treasurer.

Cupola Daubing Clay Affects Iron

Poor and Good Clays for Daubing the Cupola Defined and Results of Tests Showing Detrimental Effects of a Poor Grade of Refractory Are Given—Aluminum Additions Improve Quality

BY CARL BUBERL

MANY causes are attributed to defects in cast iron but the quality of the fireclay used in daubing the cupola is seldom if ever considered as a detrimental influence on the iron. However, it has been proved by experiments I have made that the quality of the clay does affect the iron to a marked degree. The hottest iron was obtained when the daubing in the cupola was of such quality that it could resist the heat and the action of the slag. But when poor fireclay was used for daubing, hot iron could only be produced after the clay had been washed into the slag.

When making these experiments I observed that sulphur alone has no bad effect on iron. In combination with oxide of iron or oxygen it will cause the carbon to stay in the combined state and the iron will be hard and brittle. But only in combination with iron oxide or other impurities will sulphur cause a high combined carbon, therefore, it is difficult to say to what extent the sulphur is directly responsible for the effects attributed to it. Iron was obtained with 0.18 per cent sulphur, which was rather soft and had combined carbon, 0.30 per cent; total carbon, 3.35 per cent; manganese, 0.68 per cent; silicon, 2.16 per cent. Iron of approximately the same analysis as this was run for weeks with uniformly good results. The high sulphur was caused by using high-sulphur coke and scrap which was picked up from the dumping ground and had considerable slag attached to it. This iron was melted with good results only after a high grade fireclay for daubing the cupola had been secured. With another fireclay a sulphur of 0.140 per cent proved disastrous. That brought me to the conclusion that by using poor fireclay in the melting zone, the composition of the clay is broken up and the iron absorbs something from the clay. That something I think is oxygen or iron oxide. I was not in the position to make oxygen determinations, but the fracture had the appearance of oxidized iron and I am positive that the iron was not melted below the melting zone. Then the only other place it could come from would be the daubing material and in every one of those instances the patching and part of the lining in the melting zone would be gone.

The company has two cupolas, one a Colliau with 72-inch shell and the other a Whiting with a 78-inch shell. The early part of the heat was usually bad and I soon came to the conclusion that the fireclay used for patching and daubing the cupolas was to blame and began to investigate in that line. After each 8-hour heat not only all the repair work was gone, but part of the brick lining also was gone. I condemned the fireclay and we bought some high grade fireclay which improved our melting considerably. When the first fireclay was used the sulphur in the early part of the heat was unusually high, 0.20 per cent and over, and dropped gradually until by the fifth or sixth ton it was down to 0.125 per cent and it stayed there during the rest of the heat. With the new clay the sulphur was even during the entire heat. Therefore, is was concluded that the higher sulphur at the early part of the heat with the one grade of daubing was caused by the fireclay. The new fireclay withstood the heat fairly well, but quite an impression was made in the melting zone. Still it was a great improvement over the first fireclay used. From this experience a fireclay which is unsatisfactory for use in the cupola may be defined as one that cannot resist the quick rise of temperature of the blast flame, breaks down as soon as the melting zone gets hot and deteriorates the iron; whereas a good fireclay is one that can resist the heat, can withstand quick changes in temperature and is still on the cupola wall when the bottom is dropped.

Having a large stock of the poor clay on hand I thought of all kinds of ingredients to mix with it to make it fit for use. Finally metallic aluminum was tried. Knowing the great affinity of aluminum for oxygen it was thought that it would break up the fluxing oxides in the fireclay and in that way improve the refractory qualities of the clay. One brick was made of the poor grade fireclay, and another was made of a mixture of the same clay and aluminum filings, using about 90 per cent fireclay and 10 per cent aluminum filings. The brick were air-dried for two days and then put side by side in an electric muffle furnace and heated, slowly at first then faster. The brick made of fireclay alone, cracked as soon as it got hot and disintegrated at white heat, but the aluminum-clay mixture was not affected appreciably. It did not crack nor was it possible to produce enough heat to change its shape. The aluminum-clay brick emitted hydrogen sulphide for a whole week after it was heated. After this experiment the fireclay-aluminum mixture was tried in the cupolas. When this mixture was used for daubing material, hydrogen sulphide gas was plainly distinguished at the charging door and around the tuyeres. But the heat was greatly improved, the iron came hot from the start and after dropping the bottom the most of the repair work was still there. So by the use of aluminum filings a high class fireclay was made out of a poor one. On experimenting further it was found that a fireclay-aluminum mixture containing 4 per cent aluminum would answer the purpose just as well as one containing 10 per cent aluminum. It

Interesting Theories

SOME rather radical conclusions have been drawn by the author Carl Buberl; from experiments made in his capacity as metallurgist for the D. J. Ryan Foundry Co., Ecorse, Mich. While the nature of fireclay is such that no great chemical activity would be expected from it, the results of Mr. Buberl's tests indicate that in the cupola lining it has a marked effect on the iron melted. His theories would seem to throw light on the phenomenon, known by metallurgists of the existence of sulphur in different forms in iron which determine its effects on the particular iron. Not only are the author's theories interesting, but the remedy outlined for poor daubing material should be of great value to the foundry industry if the results so far obtained can be duplicated in other shops.

withstands the heat well, only an impression being made in the lining at the melting zone. The remainder is as hard as rock after the heat, and neither slag nor coke adheres to it. Upon analyzing the iron from the first of the heat it was found to contain even more sulphur than ever before at that part of the heat, but the percentage of sulphur in the iron decreased as the heat progressed. However, the sulphur did not seem to be harmful to the iron. This brought me to the conclusion that sulphur alone is not harmful, but there must have been something else absorbed by the iron, which retained in the daubing when a mixture of clay and aluminum is used for this purpose.

Also I have observed that a poor clay used for lining ladles will spoil prefectly good iron after it has been poured into the ladles. The iron in such a case probably has been oxidized by the clay in the ladle, for it will have a higher freezing point, or as the foundrymen would say, the iron don't stand up. Poor clay will usually affect the first two or three ladlefuls of iron after which it might be assured all the impurities from the clay are either absorbed by the iron or volatilized. Therefore, it is policy to use good clay for lining the ladles and to heat the lining of the ladles to a red heat before using them. I am using an oil-air blast lamp for that purpose.

Patterns Altered To Facilitate Molding

BY M. E. DUGGAN

A KNOWLEDGE of molding practice is essential to the patternmaker and the only practical way for him to gain such knowledge is to seek the co-operation of the foundry foreman and the experienced molder in fitting up the pattern. An ideal pattern is one that causes the molder and coremaker the least amount of trouble and serves as a means of producing the casting in the quickest and most economical manner. The alert patternmaker can pick up many valuable pointers in the foundry. Short cuts and emergency measures are frequently practiced in the foundry which the patternmaker could very profitably incorporate in his mental card index of "How to do things."

It is a common trait of human nature to be proud of anything original and when the molder does develop something out of the usual run it is only natural that he should want to show it to his friends. He will send word to the patternmaker to "Come over to the foundry a minute, there is something here worth looking at." This is co-operation, it helps to make better mechanics out of the older men and practical mechanics out of the apprentices.

The way in which the foundryman had disregarded the patternmaker's idea and substituted his own in connection with two patterns is illustrated in the accompanying illustration. In both cases the job was simplified for the molder and the total cost to the company was reduced. The patterns were part of a $700 job made in a pattern shop out of town. They were for two cast-iron bearing brackets, one right hand and one left hand. There is considerable difference in the design of the two brackets but existing conditions made this necessary. The patterns were made in the same shop but by two different patternmakers.

Two mistakes were made in the construction of Fig. 1. The first mistake does not show in the illustration but it consisted in only allowing 1/16-inch finish in the recess *G*. That is not enough stock to allow the planer tool to get under the scale and as a result it is impossible to keep an edge on the tool. The least that should be allowed is ⅛ or 3/16-inch. The best way to make a job of that kind is to make the back plain with no recess and let the machinist cut it out on the planer. As but one casting was wanted the time saved in the pattern shop and foundry would have more than offset the cost in the machine shop.

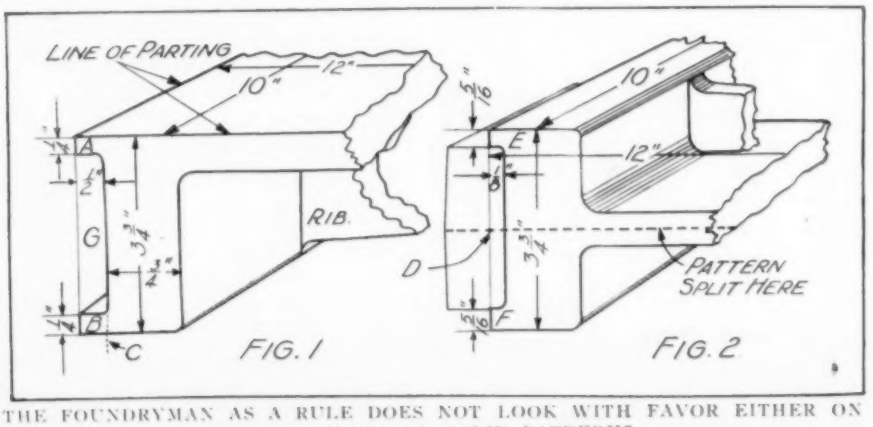
The second mistake lay in making the lip *B* loose on the pattern, so that the recess *G* could be molded in green sand. Molders as a rule do not care for a job in which they have to extract loose pieces from the side walls near the bottom of a dark mold. If any pieces of sand get dislodged they are apt to get under the lip where they cannot be seen. There are occasions when loose pieces on a pattern are desirable but in the majority of cases it is possible to construct a more workable type.

The molder took it upon himself to simplify the molding of this pattern. He selected from the stock cores a slab about 1 inch thick and cut it with a hack saw to the dimensions of the recess in the pattern. He fastened the lip *B* to the pattern and placed the core in the recess to correspond to a wooden print. He then rammed the whole pattern in the drag and after the pattern was drawn the core was returned to its original place in the mold.

The patternmaker who had made this pattern knew nothing of what happened to his pattern in the foundry because he was several miles away and it is quite probable that he might keep on repeating the same mistake until he got into actual contact with molding operations.

An example of poor judgment is shown in Fig. 2. The pattern was split through the middle on the line *D*, making the depth of the pocket one-half that of Fig. 1. The recess at the back is only ⅛-inch deep and yet a core box was made and a core print fastened on the back of the pattern. To make a mold off the pattern as it was made, meant that a special cope would have to be fitted up and the slab core at the back set in in two halves, one in the cope and the other in the drag.

The foundryman knocked the core print off, screwed the two halves of the pattern together and molded it in the drag. It did not require as many gaggers to lift the pocket as it would have done to hold the sand inside and tical mechanics out of the apprentice boys.



THE FOUNDRYMAN AS A RULE DOES NOT LOOK WITH FAVOR EITHER ON LOOSE PIECES OR SPLIT PATTERNS

Melting Process Involved in 21-Inch Cupola

Question.—I should appreciate some information on how to operate a cupola 21 inches diameter inside the lining. My work consists of medium sized castings and I propose to melt from 1 to 1½ tons a day. What is the correct height for the coke bed in a cupola that size, how much will such a bed weigh? What should the first charge of iron weigh and what should succeeding charges of coke and iron weigh? I should like to know the proper relative proportions of pig iron and scrap, stove plate and machinery to use in my work and the silicon content to specify when I order pig iron. Is it necessary to flux the furnace and what and how much material is required for that purpose? What is the proper blast pressure for a cupola of the size indicated?

Answer.—A small cupola requires to be handled more carefully than a large one. On account of the relatively smaller coke and iron charges, any deviation in the method of charging will affect the uniformity of melting to a marked degree. The iron must be broken quite small so that it may be charged closely and compactly. The aim should be to maintain an even thickness of iron in all the charges.

Under proper working conditions, a 21-inch cupola should melt about 3000 pounds of iron an hour and 30,000 cubic feet of air are required to melt one ton of iron. Consequently you will need to force 45,000 cubic feet of air into the cupola per hour, that is, 750 feet a minute. The air should be delivered at about 8 ounces pressure and a generous set of tuyeres should be provided so that the air may enter the cupola freely. A continuous set of tuyeres connected to a wind box on the outside of the cupola shell is the most satisfactory system to employ. The fan should be located close to the cupola with the blast pipe entering the wind box at a tangent.

The lower edge of the tuyeres in your case may be about 5 inches above the sand bottom. This will give you a *well* capable of holding nearly 700 pounds of iron at one tap in case you need to pour a heavy casting without having to hold the iron in the ladle for any length of time. The tuyere openings should be at least 3 inches high.

The weight of coke varies and the best way is to measure the height of the coke bed instead of weighing it. After you have established the correct height by experiment the amount then can be weighed or measured by allowing the required number of forks full. Theoretically, the bed should extend about 30 inches above the top of the tuyeres. Mark this point on the lining, then bend a light rod in the shape of a capital Z. The upper bend to rest on the sill of the charging door and the lower end to correspond with the mark.

Roughly speaking the bed will require about 250 pounds of coke. Place 200 pounds on the bed, then light the fire and after it has burned through add enough coke to bring the bed up to the lower end of the measuring rod. The cupola then is ready to charge. The weight of iron in the charge may vary between 200 and 500 pounds, but 300 pounds is fairly common practice. About 50 pounds of coke between charges of the latter weight will be found satisfactory. A little experimenting easily will determine the proper relative weights to give the best results.

For the general run of small and medium machinery castings the silicon content should range between 1.75 and 2 per cent. Approximately 0.20 per cent is lost in the cupola, therefore the mixture of iron going into the cupola should run from 2 to 2.25 per cent silicon. No. 2 foundry pig iron will average 2.25 per cent silicon. A good grade of machinery scrap will contain about 1.75 per cent silicon and stove plate scrap will run about the same or a little higher.

For castings that have to be machined, the mixture probably should be 40 per cent pig iron and 30 per cent each machinery and stove plate scrap. In castings that are not machined the pig iron content can be decreased and in some instances omitted altogether.

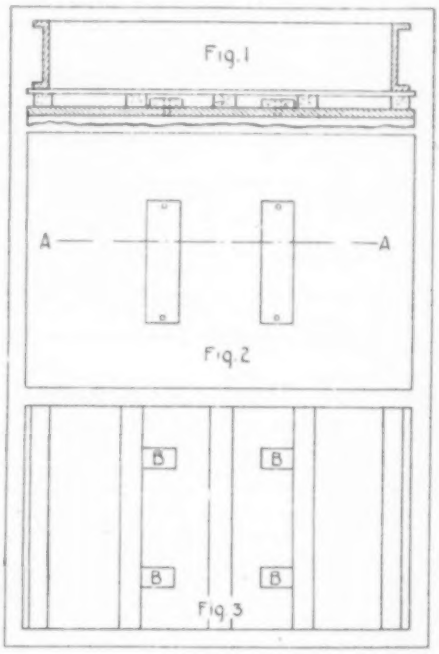
It is not necessary to draw the slag off a cupola which is only in operation for an hour, or an hour and a half. However, to keep the inside clean and prevent the slag from *bridging* and thereby retarding the melting process it will be necessary to add a shovel full of limestone, fluor spar or oyster shell to each charge of iron.

Device Prevents Flask From Creeping

By Michael R. Burns

One of the troubles incident to jolting large molds is the tendency on the part of the flask to *creep* on the table of the machine. This tendency is more pronounced in the case of steel foundries where the molds are rammed to a greater degree of density than they are in gray iron foundries. On one flask 5 feet 6 inches by 3 feet 6 inches in which the drag was jolted 100 times and the cope jolted 200 times, it was necessary to stop the machine frequently to prevent the flask from falling off the table. One jib crane served two machines and a great deal of time was lost in shifting and readjusting the flask during the ramming operation.

Finally I adopted the idea shown in the accompanying illustration and have had no trouble since. The machine can be used continuously all day without the slightest danger of the flask shifting out of position. Four ⅞-inch holes were drilled and tapped 20 inches apart and situated equidistantly from the ends and sides of the machine table. Four ⅞-inch stud bolts, 3 inches long and threaded at one end only, were screwed firmly into these holes. Two pieces of 1½-inch plank, 6 inches wide by 2 feet long and provided with 1-inch holes about an inch from each end were slipped over the bolts. When in the position shown, the outside edges of the blocks fit rather loosely against



THE BLOCKS CAN BE BOLTED TO THE TABLE EITHER TRANSVERSELY OR LONGITUDINALLY DEPENDING ON THE SIZE OF THE FLASK AND ALSO ON THE RELATIVE POSITION OF THE BATTENS ON THE FOLLOW BOARD FIG 2 SHOWS BLOCKS IN POSITION ON THE TABLE OF THE MACHINE AND FIG. 3 SHOWS THE BATTEN SIDE OF THE PATTERN BOARD

the inside edges of the battens on the follow board. In the event that the battens happen to run the other way, that is longitudinally instead of transversely, the blocks can be set the other way to correspond. The short blocks *B* shown in Fig. 3 are fastened to the follow board and come into contact with the ends of the long blocks fastened to the machine table. They prevent the flask from moving side ways.

The Bixler Coal & Coke Co., fourth floor Fulton building, Pittsburgh, of which Ira E. Bixler is president, has been appointed exclusive sales agent on foundry coke only for W. J. Rainey, Inc. in western Pennsylvania, Michigan, Ohio and West Virginia.

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Steel Castings Approach War Average

STEEL castings production, as shown by figures of the American Iron and Steel institute in 1920 was about 90 per cent of the average output for the three war years, 1916, 1917 and 1918, which established the high water mark in the industry in America. Had not the depression struck the industry during the last three months of the year, it is possible that 1920 would have surpassed the average shown. The total output of steel castings in 1920 was 1,251,542 tons. This exceeds the previous peacetime record of 1913, 1,020,744 tons by 230,798 tons or 22.5 per cent. This increase in output, in some measure, may be traced directly in increased steel foundry capacity. In 1920, 326 works were reported in 33 states, the District of Columbia, Canal Zone, Panama and Alaska, which is an increase of 16 plants over the 1919 total reporting. The 1920 total is 275,105 tons, or more than 28 per cent ahead of the 1919 figure, which covered the post armistice depression. The most significant development of the statistics covering steel castings manufacture is the marked increase noted in electric furnace production. In 1919, the total output was 111,510 tons, which was 3,214 tons ahead of the 1918 total of 108,296 tons. In 1920, a total of 155,196 tons of electric furnace steel was cast. This is an increase of 43,686 tons or 39.18 per cent in a single year. The total electric steel casting production reported last year lacks only a few hundred tons of being equal to the total output previous to Jan. 1, 1918; it is almost 42 per cent of the total tonnage made during all the years previous to 1920; and finally, the electric steel output last year lacks only 5648 tons of equalling the greatest tonnage ever recorded for bessemer steel castings, which was a total of 160,844 tons made in 1918. Acid open-hearth steel castings still maintain their ascendency with a total of 537,072 tons as compared with 449,330 tons for the basic process. Both classes of open-hearth castings record an increase, the acid process having gained 88,515 tons or about 19 per cent, while the basic process shows 449,330 compared with 313,965 tons in 1919, an increase of 135,375 tons or over 43 per cent. This is a decided reversal from the tendency evidenced during the past few years. In 1919, both the acid and basic methods showed a decrease, but the acid process lost only 29.4 per cent, while the basic dropped 37.9 per cent. The total production of open-hearth castings was 986,400 tons in 1920 and 762,520 tons in 1919, showing an increase of 223,880 tons or 29.2 per cent for steel castings of this character. The bessemer tonnage in 1920 was 104,980, while in 1919 a total of 98,819 tons were made giving a 6161-ton or 6.2 per cent increase. Continuation of high pig iron prices and the difficulty of securing iron even on contract probably accounts for the greater popularity of the open-hearth and electric processes, as scrap was more readily obtained. Crucible steel castings show an increase from 1009 tons in 1919 to 1729 tons in 1920, but no expansion is evident.

The Institute also has issued statistics on the production of cast-iron pipe and fittings. During 1920, a total of 775,523 tons of pipe and 110,992 tons of fittings are reported as compared with 612,724 tons of pipe and 97,357 tons of fittings for the previous year. A comparison of the total of pipe and fittings shows an increase of 176,434 tons or 28.8 per cent during the past year.

Trade Outlook in the Foundry Industry

ALTHOUGH no marked changes have taken place in the general industrial situation during the past two weeks, some encouragement is felt, which has its origin in recent tendencies. Railroad conditions are improving. Automobile production, although retarded, has not dropped away as was feared among all manufacturing plants. The building situation is improving, following the settlement of labor disputes in the larger centers. Indications point to an increase of car repair orders and probable purchases of new rolling stock. These points summarize the assets in the present industrial balance sheet.

Effects Not Immediate

These favorable symptoms of better health for business in a measure are lost in the present stagnation. Throughout the country foundries universally are experiencing severe depression. No single line of casting manufacture forms a marked exception to this condition, although some, notably radiator shops, are able to maintain better operations than their fellow foundrymen who for example produce agricultural implements or automobile parts. The various classes of castings producers have been reduced to the common level under the influence of prevailing quiet. Steel foundries, gray-iron shops, malleable and nonferrous casting plants alike are on extremely low schedules and all report little inquiry. No particular section of the country may boast of better conditions than any other. From coast to coast, throughout the New England states, from the Birmingham district and even in the foundry centers of Canada the same stagnation is evident. This condition constitutes the liability column in the ledger of business balance.

Prices of Raw Material for Foundry Use

CORRECTED TO JUNE 23

Iron		Scrap	
No. 2 Foundry, Valley	$22.00 to 23.00	Heavy melting steel, Valley	$11.50 to 12.00
No. 2 Southern, Birmingham	21.50 to 22.50	Heavy melting steel, Pitts.	12.00 to 13.00
No. 2 Foundry, Chicago	20.00 to 21.00	Heavy melting steel, Chicago	11.25 to 11.75
No. 2 Foundry, Philadelphia	24.85 to 25.50	Stove plate, Chicago	14.00 to 14.50
No. 2 Foundry, Buffalo	21.75 to 23.00	No. 1 cast, Chicago	14.50 to 15.00
Basic, Valley	21.00	No. 1 cast, Philadelphia	17.50 to 18.50
Basic, Buffalo	22.00 to 23.00	No. 1 cast, Birmingham	13.00 to 13.50
Malleable, Chicago	20.00 to 21.00	No. 1 cast, Buffalo	18.00 to 18.25
Malleable, Buffalo	22.00 to 23.00	Car wheels, iron, Pittsburgh	14.00 to 14.50
		Car wheels, iron, Chicago	13.50 to 14.00
Coke		Railroad malleable, Chicago	13.50 to 14.00
Connellsville foundry coke	$ 4.00 to 5.00	Agricultural mal., Chicago	13.50 to 14.00
Wise county foundry coke	6.00 to 7.00	Railroad malleable, Buffalo	11.50 to 12.50

Fundamentals Sound

Six months ago many competent business observers would have pronounced impossible the quick reduction in prices, the rapid adjustment of wages in many lines, and the early stabilization of credits which has been effected. Too, few even six weeks ago would have foretold the betterment which is evident in railroad conditions, which are taken by many to be the fundamental basis upon which improvement hinges. The first week in April showed over 500,000 idle freight cars, throughout the country. An improvement was noted for the first time during the week of April 15, and this has continued, until during the first week of June the report of the American Railway association gave 389,526 idle cars, as against 394,040 cars for the last week of May. With the improvement in traffic, the bad order cars, of course, have increased. Further, a slow building up is noted in railway finances, and some buying of new equipment is reported. All these factors, while they may mean little in a direct way to the foundry industry, presage better times. Some direct business to casting plants supplying the railroad trade undoubtedly will arise in the late summer, and this business cannot fail to bring about betterment in other lines. Freight rate reductions still are warmly agitated, but up to the present no adjustments have been made. The railroads are resisting. They demand assurance that increased traffic, carrying augmented revenue, shall precede any reductions. Some efforts are being made to adjust rates which were thrown out of line by the universal application of increases.

Price Drops Continue

Although raw materials and many basic products have reached a state of price equilibrium, reductions still continue in many manufactured articles. Reductions have been made in practically all makes of automobiles. While the effect of this movement is problematic, automobile plant operations continue better than had been expected. The Ford plant still maintains a daily schedule of 4000 cars, and 240 tractors. The Dodge company is up to full daily schedule of 450 cars, and the Studebaker Corp. has increased its output to 350 cars per day. Despite these conditions, foundries making automobile castings are working only a few days a week, and many are closed entirely. Large stocks of castings still exist and new specifications from manufacturers are held at a minimum. Cast-iron pipe sales have dropped away rapidly during the past few weeks, following a spring revival which promised well. Prices range from $40 to $45 a ton in the Birmingham district. Soil pipe and fittings shops are on a low schedule. One northern plant which normally melts 65 tons a day at present is melting only about 5 tons a week. Stove foundries in general are below 30 per cent of capacity, although improvement is noted in some sections. Sales of farm implements, notably reapers and binders are improving slowly. This is ascribed to the start of the harvest season in the south. Many farmers who had expected to use old equipment, or who had delayed buying to await bottom prices have sent rush orders for farm machinery. Malleable shops are below 25 per cent.

Prices for nonferrous metals based on New York quotations in the *Daily Metal Trade* of June 23 12.87½c to 13.00c; lead, 4.40c; antimony, 5.00c to 5.12½c; Straits tin, 29.37½c; aluminum, No. 12 alloy, open market, 17.00c to 18.00c. Zinc is 4.37½c, E. St. Louis.

Comings and Goings of Foundrymen

WILLIAM CHAMBERS, known affectionately in the foundry trade as "Uncle Billy," has resigned from the Garden City Sand Co., Chicago, with which he was affiliated for 25 years, and now is connected with the Material Service Corp., 614 Chamber of Commerce building, Chicago, in which he owns an interest. The Material Service Corp. deals in molding sand, fire brick and all kinds of building materials, such as sewer pipe, partition and drain tile, cement, sand and gravel, etc. Mr. Chambers is in charge of the fire-brick and molding sand department.

Dr. Richard Moldenke, Watchung, N. J., is back from a two months' tour of Central Europe.

E. L. Dalton has been made traffic manager of the American Radiator Co. with headquarters in Chicago.

H. B. Wilson has been placed in charge of the St. Louis office of the Mahr Mfg. Co., Minneapolis. The St. Louis office is at 915 Olive street.

George F. Pettinos, Real Estate Trust building, Philadelphia, importer and manufacturer of foundry supplies, returned recently from a business trip to Europe.

N. E. Lyle, for many years connected with the Columbia Graponola Co., has been made vice president of the Terminal Engineering Co., Inc., 17 West 44 street, New York City.

R. E. Turnbull, Arcade Mfg. Co., Freeport, Ill., who has charge of molding machine sales for this company, sailed for Europe on the MAURETANIA Wednesday, June 15. While abroad Mr. Turnbull will visit England, Scotland, France and Belgium.

W. L. Chatfield with R. J. Koch recently has organized the Charleston Electric Steel Foundry Co., Charleston, W. Va. Mr. Chatfield formerly was superintendent and plant manager for the Central Foundry Equipment Co., Nitro, W. Va., and previous to that he was foundry superintendent for the Kanawha Mfg. Co., Charleston, W. Va.

Ernest F. Perkins, metallurgist for the Oliver Chilled Plow Works, South Bend, Ind., has been appointed instructor in the school of engineering of Northeastern college, Boston. Joseph W. Zeller, who has been engaged in engineering work in Worcester, Mass., the past year, has been appointed assistant professor of mechanical engineering in the same school.

William H. Woodin, president of the American Car & Foundry Co., New York, was elected a director of the Westinghouse Electric & Mfg. Co., East Pittsburgh, at its stockholders' meeting last month.

Edward D. Frohman, manager of the S. Obermayer Co., Pittsburgh, and W. S. Bartholomew, vice president of the Westinghouse Air Brake Co., Wilmerding, Pa., were delegates from the Pittsburgh chamber of commerce who attended the International Chamber of Commerce meetings held in London, England, June 27 to July 2.

Robert E. Belt, secretary and treasurer American Malleable Castings association, Cleveland, has been appointed to fill a vacancy on the national board of directors of the Industrial Cost association. A. A. Alles Jr., Peoples Bank building, Pittsburgh, is secretary of the cost association.

J. Champlin Pierce Jr. has been made foundry superintendent for the J. B. Cook Auto & Machine Co., Memphis, Tenn. Mr. Pierce formerly was connected with the Farrell Foundry & Machine Co., Ansonia, Conn. and subsequent to that time was with the National Sanitary Co., Salem, O. Mr. Pierce was graduated from the McLain System school, Milwaukee.

New England Foundrymen Meet in Hartford

The annual joint meeting of the New England Foundrymen's association and the Connecticut Foundrymen's association was held at the Garde hotel, Hartford, Conn., on June 8. Over 100 foundrymen from the various industrial districts of New England were in attendance. Thomas Kelley who was scheduled as the speaker of the evening was absent due to sickness and the program was therefore open to general addresses and discussions.

Institute Will Meet in Birmingham Next Fall

The fall meeting of the British Institute of Metals will be held in Birmingham, England, Sept. 21-23. At the morning session Sept. 21, an address of welcome will be delivered by the Lord Mayor of Birmingham, and the remainder of the session will be devoted to the reading and discussion of papers. After an official luncheon, a visit will be made to the University of Birmingham where tea will be served. In the evening there will be a reception by the Lord Mayor.

A second meeting for the reading and discussion of papers will be held on Sept. 22, after which there will be a garden party. The concluding day, Friday, Sept. 23, will be devoted to an automobile trip to Warwick and Kenilworth castles and Stratford-on-Avon. Tea will be served at the home of Sir Gerard Muntz, Stratford. The local reception committee for the meeting will consist of Sir Gerard Muntz, chairman, past president of the Institute, and head of Muntz's Metal Co., Birmingham; George W. Mullins, honorary local secretary; and George Bill-Gozzard, honorary local treasurer.

Foundryman Heads Southern Metal Trades

C. F. Meehan, Ross-Meehan Foundries, Chattanooga, Tenn., was elected president of the Southern Metal Trades association, at the fourth annual convention of that organization held in Asheville, N. C., June 21. Mr. Meehan succeeds W. T. Harding of Raleigh. Other new officers are: Vice president, J. D. Dore, Houston, Tex.; secretary, W. E. Dunn Jr., Atlanta; treasurer, J. W. Moore, East Point, Ga. State vice presidents are: Charles R. Law, Louisiana; G. C. Holmgren, Texas; J. M. Brown, Florida; E. F. Billington, Mississippi; F. L. Dilley, Arkansas; George Dewey, North Carolina; T. L. Siddal, South Carolina; John S. Schofield, Georgia; Winfield Clark, Alabama.

Pittsburgh Foundrymen Hold Annual Picnic

Members of the Pittsburgh Foundrymen's association numbering over 200 held their annual picnic at the Willows, Oakmont, near Pittsburgh, June 20. Boating, bathing, and a base ball game were some of the major events on the program, along with other athletic sports. A prize quoit match between Henry B. Spilker, Sterritt Thomas Foundry Co. and A. J. Hartman, United Engineering & Foundry Co., president of the Foundrymen's organization, which ended in a tie at

darkness, will be played off some time during the next two weeks, the winner to be presented with a solid gold watch and chain. Judge Miller of the county court and Rev. J. A. Tratis, were the speakers after the dinner held in the Willows dining room which was followed by a short business session. The following committee had charge of the outing: Chairman, J. S. McCormick, J. S. McCormick Co.; H. B. Spilker, John Field, and John W. Guay, the latter two being connected with the Fort Pitt Steel Casting Co.

Plumbago Imports Shrink

United States imports of plumbago in March amounted to 1162 tons, valued at $81,360, compared with 1490 tons valued at $100,146 in March, 1920, states the bureau of foreign and domestic commerce, at Washington. In the nine months ended with March, 1921, imports totaled 12,395 tons valued at $1,019,764, against 15,405 tons valued at $1,801,016 in the nine months ended with March, 1920. In March, 1921, the United States exported 121,596 pounds of unmanufactured plumbago, valued at $9913, and manufactured plumbago valued at $69,828.

Not Easy to Desulphurize in Acid Furnace

One of the main handicaps of the acid lining for the electric furnace is that it is generally thought sulphur cannot be removed from the metal when such a lining is used. Therefore considerable interest was manifested in the article, "Sulphur Reduced in Acid Lined Furnace" contributed by Walter L. Morrison and published in THE FOUNDRY of May 15. The following comments of George K. Elliott give his experience in removing sulphur from iron using an acid lining in the furnace.

Mr. Elliott says:

The idea of using a calcareous slag in an acid-lined furnace naturally appears to be metallurgically unorthodox, but the writer has found that in a pinch it can be turned to account with fair success provided the obvious hazards of the situation are carefully safeguarded against.

Working under the stress of emergency, the writer has had occasion to resort to the practice outlined in the article mentioned. The best results were attained when the run of successive heats were not too intensive, and when the amount of sulphur reduction continuously required was not excessive. In one notable instance the attempt was made to desulphurize gray iron under uninterrupted working conditions in an acid-bottom electric furnace by the judicious use of a coke-bearing lime slag. The furnace was duplexing, i. e., working in tandem with a cupola, running almost continuously day and night, and it is not surprising that under these conditions the practice proved so destructive to the acid refractories of the hearth that its abandonment and the substitution of a basic hearth became imperative.

It seems that for casual or not too intensive running, and for moderate desulphurization of cast iron the method using a lime-coke slag in an acid-lined electric furnace can be employed provided the necessary precautions are exercised. On the other hand, for constant rigorous service, the writer finds the use of basic-bottom furnaces preferable.

Features Portable Cupola

An attractive folder issued by the Constructional Engineering Co., Ltd., Titan Works, Birmingham, England directs attention to the insistent cry in every line of business, to the necessity of cheapening production without loss of quality. In this connection the company submits a record of some of its own achievements along this line. The company specializes in the manufacture of foundry equipment including air receivers, cupolas, permanent and portable, charging machines, core stoves, electric winches, ladles, hoists, hand and electric molding machines, flasks and rigging, runways, sand mills, tumbling barrels and sand handling equipment. Interesting and detailed information is given covering the performance of several sizes of small compact, self-contained, melting units, one of them mounted on wheels is employed by a municipal corporation for welding rail joints. In addition to furnishing foundry equipment for the British, French and Belgian governments the company states it has installed plants in the Argentine, British East Africa, Brazil, Egypt, Greece, Holland, India, Italy and New Zealand.

Philadelphia Foundrymen Hear Banker

The Philadelphia Foundrymen's association held its 308th meeting June 8 at the Manufacturers' club. Charles Lyon Chandler, manager foreign trade department, Corn Exchange National bank, Philadelphia, spoke on world trade conditions.

Belgians Hold Exhibit

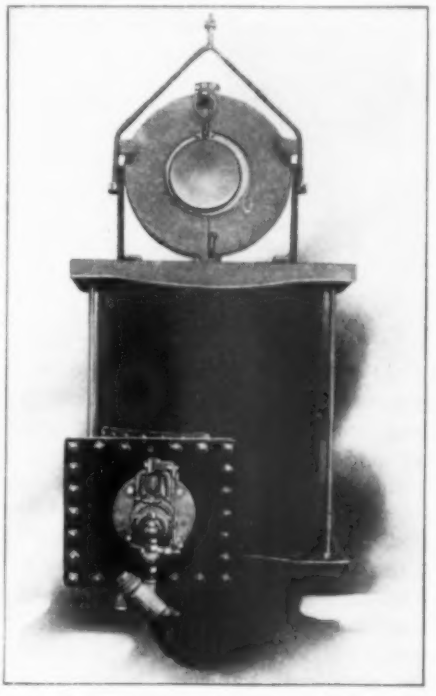
The Technical Foundry association, Liege, Belgium will celebrate its 10th anniversary by holding a foundry exposition similar to that which was held in Paris in 1913. The association solicits the co-operation of molding machine and other foundry equipment manufacturers. J. Leonard is secretary.

Tunnel Bids Probably Will Be Asked Soon

A settlement has been reached in the controversy between the New York and New Jersey tunnel commissions over the Jersey City exit and entrance to the terminal of the proposed vehicular tunnel, which is to connect New Jersey with New York. As a result, Chief Engineer C. M. Holland, 31 Chambers street, New York, now is making active preparations to issue invitations for bids on the work of building the tunnel.

Builds New Pit-type Crucible Furnace

A new crucible furnace of the pit type for melting nickel and nonferrous alloys has been put on the market



FURNACE WITH COVER OPEN AND GRATE DROPPED

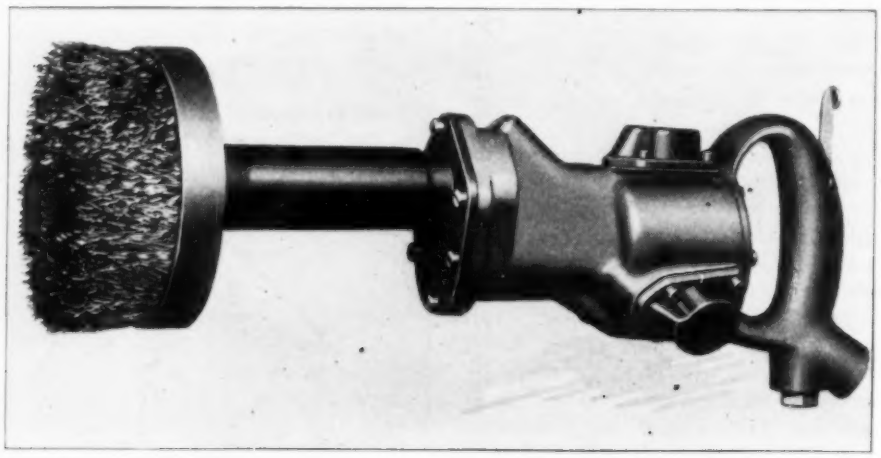
by the Anthony Co., Long Island, N. Y. This furnace is designed to burn oil, gas, coal or coke. The cover is made in two counterweighted parts, as may be noted from the illustration which shows the lid raised to expose the entire opening.

The lower is a circular brick slab with a 6-inch hole in the center for adding the charge or feeling the metal while running. The upper slab is a circular firebrick 10 inches in diameter, fastened to the main cover with a link so as to be easily shifted. A grate, hinged to lugs and securely keyed in position is provided. The top and bottom plates are gray-iron castings, 1⅛ inches thick and strongly ribbed. The shell is a 3-16-inch riveted

steel plate. The space between the firebrick and the shell is packed with asbestos to prevent excessive radiation. The oil burner operates on 8 ounces fan blast and 35 to 80 pounds oil pressure.

Designs Brush for Use on Standard Drill

A wire brush of rugged design recently has been placed on the market by the Ingersoll-Rand Co., 11 Broadway, New York, for use with its standard



THE WHOLE OUTFIT WEIGHS ONLY 11½ POUNDS

No. 6 drill. The brush has a face diameter of 5 inches, is made up of wire of a special heat-treated steel which has been found to have good wearing qualities, and is sturdily constructed.

The drill has bearings to take up the end thrust when pressing down on the work; a high-speed motor, and moreover is of light weight and small overall dimensions. It may be used in sharp corners and other cramped places. The whole outfit weighs only 11½ pounds. The wire brush equipment is adapted for removing paint, rust, scale and dirt from tanks, steel cars, structural steel, sheet metal surfaces and castings.

Dump Body is Mounted on Industrial Truck

The combination of end dump body and electric industrial truck shown in the accompanying illustration recently has been placed upon the market by the Yale & Towne Mfg. Co., Stamford, Conn. The dump body and its mounting is a detachable feature which can be set up in a few minutes on any of the platform type of Yale trucks. The particular type of body shown in the illustration has a capacity of 27 cubic feet and is so constructed that when the catch is released the weight of the material automatically rolls the body back to such an extreme pitch that even moist material will dump readily.

When all the material is out, the body is so light that one man with one hand easily can return it to the original position. The catch is so arranged and connected by a chain to the driving platform that the driver, if facing the body instead of away from the body as shown in the illustration, can run the truck up to the unloading point and pull the chain just before coming to a dead stop. Then if he applies the brakes quickly the momentum will roll the dump body up on end and discharge the contents. After the material has been cleaned out all the driver has to do is to pull the chain. The dump body will snap back into position where it once more will be engaged by the catch. The driver does not need to leave the platform for either dumping or replacing.

In a series of time and motion study tests recently conducted by the Yale & Towne Mfg. Co., at its own plant in Stamford, Conn., unloading molding sand from the railroad cars and conveying it to a storage building, it is claimed that one of these trucks did the work in two thirds of the time taken by a gang of laborers with wheelbarrows and at approximately one third of the cost.

The truck is built with a low, one-piece drop-frame platform 11 inches above the ground. The storage batteries are situated directly over the driving wheels instead of being underslung beneath the load platform and are securely clamped in a steel tray or compartment which is mounted between heavy compression and rebound springs. A weather proof controller box is located in a readily accessible place on the front end.

An automatic circuit breaker prevents movement of the truck unless the operator is on the platform. Centralization of the current to one renewal arcing contact automatically opens or closes the electrical circuit just prior to the functioning of the primary load contacts, thereby eliminating arcing between controller fingers and drum segments, regardless of the ampere demand. A hollow, semicircular, molded-composition drum provided with all copper segments, attached by machine screws from the inside, lessens the possibility of poor contact between controller fingers and segment screw heads. All contact copper units are made from pure rolled electrolytic copper assuring maximum conductivity and life to these parts. The driving

THE DUMP BODY AND MOUNTING IS DETACHABLE AND MAY BE USED OR NOT DEPENDING ON THE CHARACTER OF THE MATERIAL TO BE HANDLED

units consist of two totally inclosed motor-in-wheels connected by a cross reach steering rod to two trailing wheels, the vertical movement of the steering handle cramping or turning all four wheels simultaneously.

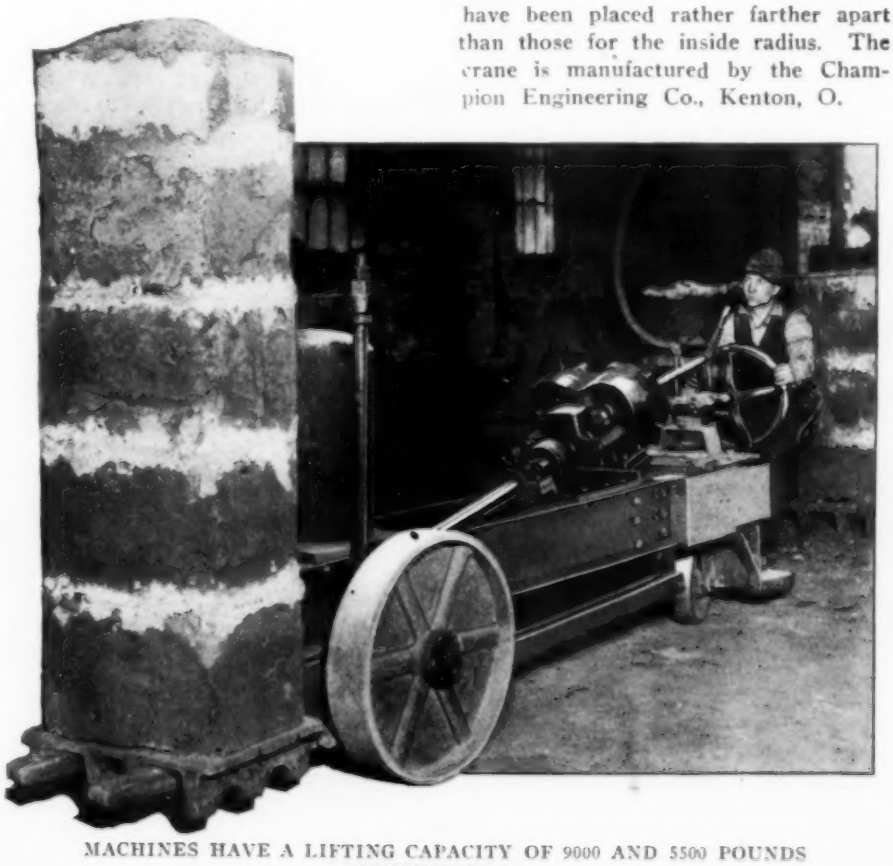
Pneumatic Charging Truck Made in Two Sizes

The American Foundry Equipment Co., 366 Madison Ave., New York, recently has developed and placed on the market a pneumatic charging machine one of which is shown in the accompanying illustration. This is designed for use in malleable foundries. These trucks are built in two sizes, similar in design but differing in capacity. The smaller has a lifting capacity of 5500 pounds at a working pressure of 60 pounds and the larger machine has a lifting capacity of 9000 pounds at the same pressure.

The truck operates by reciprocating type air motor of standard design. The drive transmission comprises a standard motor truck differential, the shafts of which carry a steel pinion in engagement with internal gears in the periphery of the two forward wheels. Air is supplied by a flexible hose connection. A throttling pedal controls the motor speed, and a hand lever the direction, forward or back. The truck is steered by a standard motor truck hand wheel. It is claimed that exceedingly short turns may be made, in fact that the machine will almost pivot on its forward wheels.

Compressed air also is employed to raise and lower the steel tangs which carry the load. A convenient hand lever admits or discharges air to or from a vertical cylinder, the piston of which carries a steel yoke connected to a pair of steel pivoted lifting levers. The tangs are a forward extension of these levers, solidly dovetailed and bolted on. This type of mechanism is positive in its action, but at the same time is smooth and free from jar.

All parts of the lifting mechanism between air cylinder and load are of heavy steel construction. Ball bearings are used throughout the machine and contribute materially to its ease of operation.



MACHINES HAVE A LIFTING CAPACITY OF 9000 AND 5500 POUNDS RESPECTIVELY

Improved Circular Crane

Several modifications have been made recently to an overhead traveling crane designed for service on a circular track. With the new construction, as shown in the accompanying illustration, all track wheels, gears and pinions are of the same size excepting one gear and pinion at the center of the bridge.

The crane shown in the illustration was built for installation in a railroad round house and has a span of 75 feet. It will be noticed that the track wheels for the outside radius have been placed rather farther apart than those for the inside radius. The crane is manufactured by the Champion Engineering Co., Kenton, O.

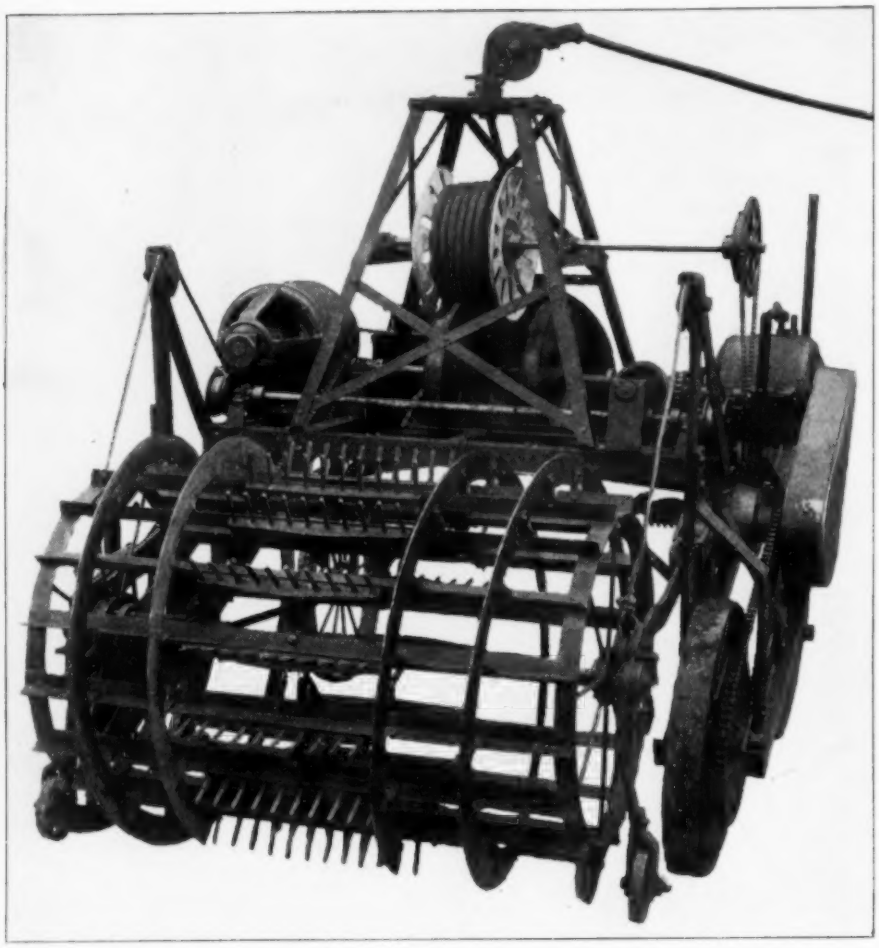
ALL TRACK WHEELS ARE OF THE SAME SIZE ON THIS CRANE, WHICH IS DESIGNED TO OPERATE ON A CIRCULAR RUNWAY

A New Type Sand Cutter

An original type of sand cutting machine operating with a 5-horsepower motor and which it is claimed will cut 100 sand heaps in 8 hours at an approximate cost of 10 cents a heap is shown in the accompanying illustration. It was invented and patented by a molder, Russel C. Stokes, and now is manufactured by the Stokes Manufacturing Corp., Dover, N. J., of which he is president.

The machine is constructed with structural iron frame, cast steel forks and rakes, aluminum transmission and cable spool. The wheels are provided with forged rims and wrought iron spokes fitted into strong, rigid hubs. They are mounted on Hyatt roller bearings. The drum is made of angle iron attached to forged rims and blades and provided with a cast steel rake mounted on the center of each angle iron. The drums also are mounted on Hyatt roller bearings. The rakes on the drum are mounted on hinges and are held in place by coil springs which allow them to deflect when they strike an obstacle. The drum also is fitted with a mechanical device which automatically throws it out of gear when it comes into contact with any heavy object.

The front running gear is mounted in a bolster so hinged in the center



A LIGHT BUT RIGIDLY CONSTRUCTED SAND CUTTING MACHINE OPERATED WITH A 5-HORSEPOWER MOTOR

as to allow for irregular floors and is substantially braced with radius rods. The cast steel forks are mounted on ball bearings which make it easy to guide. The steering is accomplished by the traction wheels having an independent clutch drive. When the steering wheels are turned to the right the drive wheel on the right hand side rotates slower while the drive wheel on the left hand side rotates at normal speed.

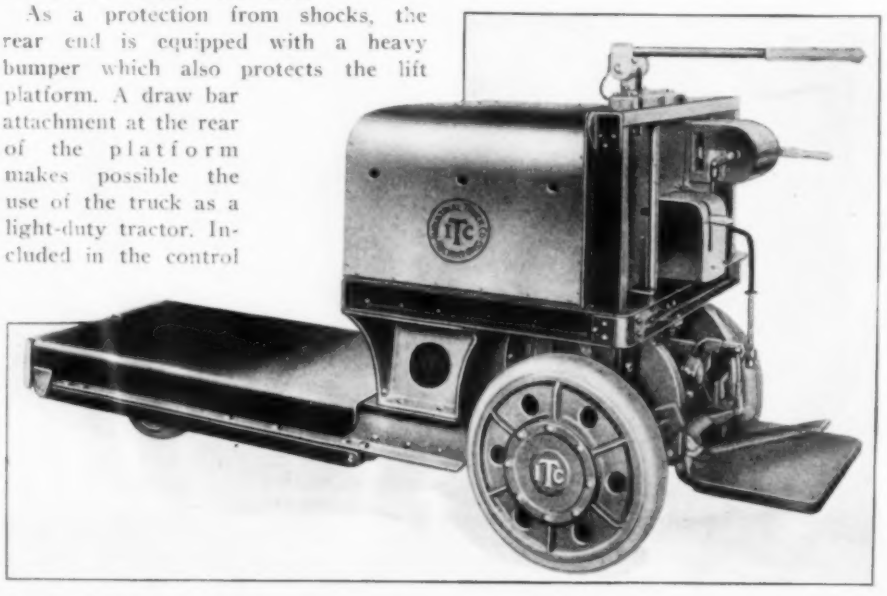
The drum is raised and lowered by power transmitted through bevel friction and worm gears. The cable for electric driven machines is carried on a spool and is coiled or uncoiled automatically and always is kept taut. Heavy disk sprocket wheels and extra heavy type roller chains are used throughout and all chains are guarded.

All-Steel Lift Truck Has Two Motors

Of recent introduction to the industrial truck field is a 2½-ton, all-steel, electric storage battery lift truck manufactured by the Industrial Truck Co., division of the Cowan Truck Co., Holyoke, Mass. The platform, as shown by the accompanying illustration, lifts vertically through a distance of 4½ inches by means of a lifting mechanism beneath the platform and operated by an independent, heavy-duty, series-wound motor and gear reduction. The travel of the platform may be stopped at any point. Material for moving is piled on skids under which the platform is backed and raised to take the load.

As a protection from shocks, the rear end is equipped with a heavy bumper which also protects the lift platform. A draw bar attachment at the rear of the platform makes possible the use of the truck as a light-duty tractor. Included in the control apparatus is an automatic brake, a circuit breaker, and a four-wheel steer. Drive is through a single reduction worm gear from the motor to the power axle. The controller is of the drum type with three speeds forward and three reverse. Either alkaline or lead storage batteries are used.

Intersecting aisles 60 inches wide will permit operation, the turning radius being 7 feet 10 inches. The length of the truck is 8 feet 6 inches overall, the width is 3 feet and the height 4 feet 3 inches over the steering shaft head. By folding the foot pedal and steering handle to a vertical position, the length is shortened to 7 feet 7½ inches for use on elevators.



A LIFTING MECHANISM WITH INDEPENDENT MOTOR RAISES THE PLATFORM 4½ INCHES

Purchase Machine Plants

The Greenfield Tap & Die Corp., Greenfield, Mass., has purchased the capital stock of the Greenfield Machine Co., Greenfield, Mass., manufacturer of cylindrical and universal grinders, and the Morgan Grinder Co., Worcester, Mass., manufacturer of internal grinders. The organization of both plants will remain unchanged. Ralph L. Morgan is president, L. M. Crittsinger, treasurer and Charles E. Hildreth, general manager of the Morgan company; E. F. Smith is president and Joseph G. Stevens, treasurer, of the Greenfield Machine Co.

The E. J. Woodison Co., Detroit, has established a warehouse and branch sales office at 261 Wellington St., West, Montreal, Canada.

The Carper Foundry Machine Co., Beckley, W. Va., has changed its name to the Raleigh Foundry Machine Co.

Quiet Governs in Equipment Market

Occasional Inquiries Seldom Are Followed by Orders—Western Manufacturers Are Selling Cupolas and Miscellaneous Machinery in Small Quantities in the East

FEW inquiries are being made for foundry equipment as June draws to a close. Stagnation in foundry operations has served to curtail even the occasional interest, and the market is more nearly at a standstill than at any time since the depression started. The Ford Motor Co., Detroit, still is interested in molding machines, but is buying only for immediate needs. The Sandusky Foundry & Machine Co., Sandusky, O. recently has purchased the buildings and dock property of the Schoepfle Mfg. Co. of that city and later will install large electric furnaces to replace smaller ones now in service.

Tentative Inquiries in the East

EASTERN foundries, with few exceptions, are operating at a very low rate. Some are looking for new castings to occupy their idle capacity, with the result that they are inquiring in many cases for new equipment which they would require in producing such new work. These inquiries involve pattern mounting equipment and molding machines for specific jobs. However, the percentage of these inquiries resulting in business is small. Another class of inquiries includes an occasional request for a price on a core oven, sand-blast equipment, or some other foundry unit, but as a rule, there is no real intention to buy and the interest is limited to the price. The International Nickel Co., which has been negotiating for a couple of months for two electric furnaces for its new plant at Huntington, W. Va., is expected to close for these units. The only electric furnace business placed in the east of late involves two furnaces placed by the Chapman Valve Co., Indian Orchard, Mass., with the Pittsburgh Electric Furnace Corp., Pittsburgh. The Rockville Iron Foundry Co., Rockville, Conn., has been incorporated recently for $50,000 by H. C. Murlless.

Pittsburgh Inquiry Light

IN line with conditions in the iron and steel industry generally, the foundry equipment activity in the Pittsburgh district is dwindling. During the past two weeks, inquiries have dropped off considerably and orders are not being placed. This applies not only to molding machines, manufacturers of which report that no inquiries now before them are considered at all promising; but to core-making equipment, ladles, and in fact everything used in the foundry including small supplies. No new construction is going on. Additional foundries are joining the inactive list while others contemplate further retrenchments. The Elwood City Foundry & Machine Shop is reorganized as the Ellwood City Foundry & Machine Co., Ellwood City, Pa., with $75,000 capitalization. It shortly will be in the market for pattern and machine shop equipment and possibly other supplies. The Bridge port Foundry & Machine Co., Bridgeport, Pa., recently was organized with $5000 capital and it is understood contemplates early purchase of equipment of various kinds. The report published two weeks ago that the United Engineering & Foundry Co., Pittsburgh, had purchased a 15-ton crane with auxiliary proves to be erroneous, this award still being held in abeyance. The demand for cranes among foundries at present is practically nil. The F. J. Ryan Co., Philadelphia recently has been awarded contracts for the furnace and burner equipment at the plant of the Philadelphia Spring Co.

Chicago District Ships to the East

WHILE demand for foundry equipment in the west shows practically no change and is exceedingly slack, some dealers find better demand from the east. A manufacturer of cupolas recently shipped two to Tennessee and two others to eastern Pennsylvania, while two more went to other eastern users. In the crane market no demand is being received from foundries and such small business in this line as comes at all is from other users. A manufacturer of sand mixing machines finds better business in the east than locally and recently has made several shipments into Atlantic states. Dealers in general supplies find some business, but only in proportion to present foundry operations, most buying being in small quantities and strictly from hand-to-mouth as small castings contracts are taken. The National Engineering Co. recently shipped a 6-foot sand mixer to England. This follows shortly after a similar shipment to South America. Export demand for this equipment is better than usual. The Lacrosse Tractor Co., Lacrosse, Wis., has accepted an offer from the chamber of commerce of Oshkosh, and shortly will remove to the latter city. The move is made to effect a consolidation of the foundry and machine shops which in Lacrosse are separated. A. D. Paine, 22 E. New York Ave., Oshkosh is handling the transfer.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The plant of the Ansonia Foundry Co., Ansonia, Conn., recently was damaged by fire.

The foundry of the New England Steel Castings Co., East Longmeadow, Mass., recently was damaged by fire.

The Atlas Machine & Foundry Co., Birmingham, Ala., plans the erection of a plant building.

The A. H. Anderson Foundry, 218 Ann street, Chicago, recently increased its capital stock from $5000 to $100,000.

The American Aluminum-Metal Products Co., Los Angeles, has purchased five acres on which it plans to erect a modern plant.

The East Moline Engineering & Mfg. Co., East Moline, Ill., has let a contract for the erection of a foundry building, 60 x 100 feet.

The plant of the Scranton Electric Steel Co.,

Scranton, Pa., which was recently damaged by fire, will be rebuilt.

The Keeley Stove Co., Second and Linden streets, Columbia, Pa., plans the erection of a plant building, 30 x 50 feet.

Bids have been closed for the erection of a foundry building for the Springfield Bronze Co., Springfield, Mass.

The foundry owned by Fleming Bros., Cabot street, Halifax, N. S., recently was damaged by fire.

The capital stock of the Brooklyn Foundry Co., Brooklyn, N. Y., recently was increased from $25,000 to $100,000.

The foundry owned by the Desjardins Foundry Co., St. Andre, Que., recently was damaged by fire. It is expected the building will be rebuilt.

Capitalized at $50,000, the Master Piston Ring Corp., New York, recently was incorporated by S. S. Budlong, B. Bursch and J. I. Polstein, 217 Broadway.

The American Fork & Hoe Co., Ashland and Lewis streets, Philadelphia, plans the erection of extensions and improvements to its plant.

The C. S. Mfg. Co., Nutley, N. J., has been organized to engage in the manufacture of automatic valves, etc., by Carl Schneider, 28 Woodland avenue, and others.

Capitalized at $5000, the Bridgemont Foundry & Machine Co., Bridgeport, Pa., recently was incorporated by Theodore J. Parry, Germantown, Pa., and others.

The Lizard Creek Foundry Co., Lehighton, Pa., recently filed articles of incorporation. It is capitalized at $50,000 and was incorporated by C. W. Bower and others.

The Faultless Piston Ring Co., Dalton, Ga., recently was incorporated with a capital stock of $200,000, by O. M. Lanham, George Garrison, both of Rome, Ga., and others.

The Bristol Stove & Foundry Co., Bristol, Va., recently was incorporated with a capital stock of $50,000, by H. E. Wilkinson, J. C. Rucker and others.

Capitalized at $30,000, the Standard Foundry & Machine Co., Punxsutawney, Pa., recently was incorporated by B. B. Thompson and others.

The Pennsylvania Die-Cast Products Co., Philadelphia, has leased a 4-story building at 1736 Sansom street, in which it plans to establish a new plant.

The foundry of the Albert Russell & Sons Co., brass founder, Newburyport, Mass., recently was damaged by fire. It will be rebuilt.

To manufacture iron and steel castings, the South Jersey Iron Foundry, Inc., Pleasantville, N. J., recently was organized by W. C. Arnold, Commonwealth building, Philadelphia, and others.

The F. H. Koretke Brass & Mfg. Co., 922-26 Magazine street, New Orleans, plans the erection of an addition to its brass foundry. W. E. Gosselin is vice president and general manager of the company.

The Alco Foundry & Machine Co., Wellston, O., has purchased the property of the Hamden Foundry Co., and is making alterations and improvements for the production of gray iron castings.

The Farmers Tractor Co., originally organized at Oshkosh, Wis., has changed its location to Stevens Point, Wis., where it will establish permanent works during the summer.

The Newark Engine & Machine Works, 85 Frelinghuysen avenue, Newark, N. J., recently was organized to engage in the manufacture of machinery and parts, by Peter A. Burtz, 40 Halleck street, and others.

The Superior Brass Works, Inc., Detroit, recently was incorporated with a capital stock of $40,000 by Carl W. Thurmes, John M. Burke, 262 Chalmers avenue, Frank M. Klump and others.

The Waukegan Foundry Co., Waukegan, Ill., recently was incorporated to engage in the manufacture of gray iron castings, and it is now having plans prepared for the erection of a plant.

The Ellwood Foundry & Machine Shop has been reorganized with a capital stock of $75,000, and now is known under the name of the Ellwood Foundry & Machine Co., Ellwood City, Pa.

The Beaver Pattern & Mfg. Co., Beaver Dam, Wis., is the new corporate style selected by the former Erickson Pattern & Mfg. Co., which was established about two years ago to manufacture wood and metal patterns for foundries.

A plant for the manufacture of valves for irrigation machinery and shaft couplings for transmission equipment, will be erected at Berkeley, Cal., by the Green-Shaw Co. The building will be built at an estimated cost of $20,000.

The Hood Turbine Co., Boston, has been incorporated to build turbine engines with a capital stock of $100,000, by Curtis D. Chase, Natick, Mass., Robert J. Hurley, Revere, Mass., Walter H. Smart, Framingham, Mass., Arthur K. Bayley, Danvers, Mass., and Joseph S. O'Neil, Belmont, Mass.

The plant and grounds of the Sweeney Foundry & Shipyard Co., Jeffersonville, Ind., recently was sold to the First National bank of Louisville. The sale included valuable frontage and all the buildings and yards of the company, the affairs of which have been in litigation for some time past.

Capitalized at $10,000, the Hudson River Foundry Co., Poughkeepsie, N. Y., recently was incorporated by J. Hanson, H. B. Vosburgh, C. W. H. Arnold and others.

The capital stock of the G. A. Ball Bearing Mfg. Co., 3051 West Lake street, Chicago, recently was increased from $75,000 to $200,000.

The Trenton Chilled Die & Casting Co., Trenton, N. J., which was recently organized, has advised that it is located in a plant at the foot of Houghton avenue, which is fully equipped for the manufacture of its products. Officers of the company are: President, John H. Conover, treasurer, R. B. Newton, and secretary, B. N. Rich.

First articles of incorporation for the Rockville Foundry, Rockville, Conn., recently were filed and final articles will be placed on file shortly, according to an announcement by the company. The company is an established business having been organized about 85 years ago. It recently completed the erection of an addition and its capacity is now about 10 tons a day.

Reports are current to the effect the Gray Iron Foundry Co., Muskegon, Mich., and the Alamo Furnace Co., Chicago, have been merged under the name of the Smith-Gray Heater Co. It is stated the Chicago plant will be moved to Muskegon. Officers of the new organization are: President, Charles Smith; vice president, C. H. Mee; treasurer, E. L. Meier and secretary, W. A. Meier.

The Canadian Farm Implement Co., Vancouver, B. C., has been incorporated with a capital stock of $1,000,000, to acquire and take over the plant and business of the Canadian Mower Improvement Co., Ltd. It will carry on business as iron founder, brass founder, metal worker, machinist, etc. Incorporators of the company are Ghent Davis, Donald G. Marshall, James C. Ralston and others.

Announcement has been made to the effect the Sandusky Foundry & Machine Co., Sandusky, O., has purchased the buildings and dock property of the Schoepfle Mfg. Co., that city. It is understood the new owner will remodel the property and make some extensions to be used for power plant facilities. During the past year the capacity of the company's machine shop has been tripled by additions to machinery and equipment and larger power plant facilities are needed for further expansion, which ultimately will include the installation of electric furnaces replacing the ones now in use.

The Lacrosse Tractor Co., Lacrosse, Wis., has accepted the offer of the chamber of commerce of Oshkosh, Wis., to relocate its works and offices in that city. The Oshkosh Tractor Co. has been incorporated to take over the property. The new company has a capital of $1,500,000 of preferred stock and 15,000 shares of common without par value. It has engaged Architects Auler & Jenson, of Oshkosh, to prepare plans for the first unit of a new factory, 150 x 500 feet, to be ready about Sept. 1.

New Trade Publications

STARTING SWITCH.—A folder in which a safety starting switch for alternating current motors of the squirrel cage type is described and illustrated, recently was published by the Cutler-Hammer Mfg. Co., Milwaukee.

CUPOLAS—The Whiting Corp., Harvey, Ill., is circulating a 32-page booklet containing a list of users of cupolas which it manufactures.

CRANES—Electric traveling cranes are described and illustrated in an 8-page illustrated booklet recently published by the Pittsburgh Crane & Equipment Co., Pittsburgh. Full data are given as to the various sections and parts of the cranes and a number of the illustrations are of actual installations.

CHARGING MACHINES.—Horizontal Open-hearth charging machines are described and illustrated in a 36-page illustrated booklet recently published by the Morgan Engineering Co., Alliance, O. The bulletin calls attention to the prominent features of the equipment and shows the variety of chargers which the company manufactures. These chargers are made for various capacities, for any required span and for either direct or alternating current.

HOISTS.—The Euclid Crane & Hoist Co., Euclid, Cleveland, is circulating a 48-page illustrated booklet in which electric hoists, electric monorail trolleys, electric traveling cranes and electric wall and jib cranes are described and illustrated. Specifications, etc., are given, and the illustrations show actual installations of the various equipment.

CONTROL DEVICE.—What is said to be a new departure in combustion control devices is described and illustrated in a bulletin recently issued by the Mono Corp. of America, New York. According to the folder, this device is unique in that it automatically analyses and records the combined percentages of three combustible gases during all such times as any or all of them appear in the flue, while it also produces a continuous accurate record of the percentage of CO_2.